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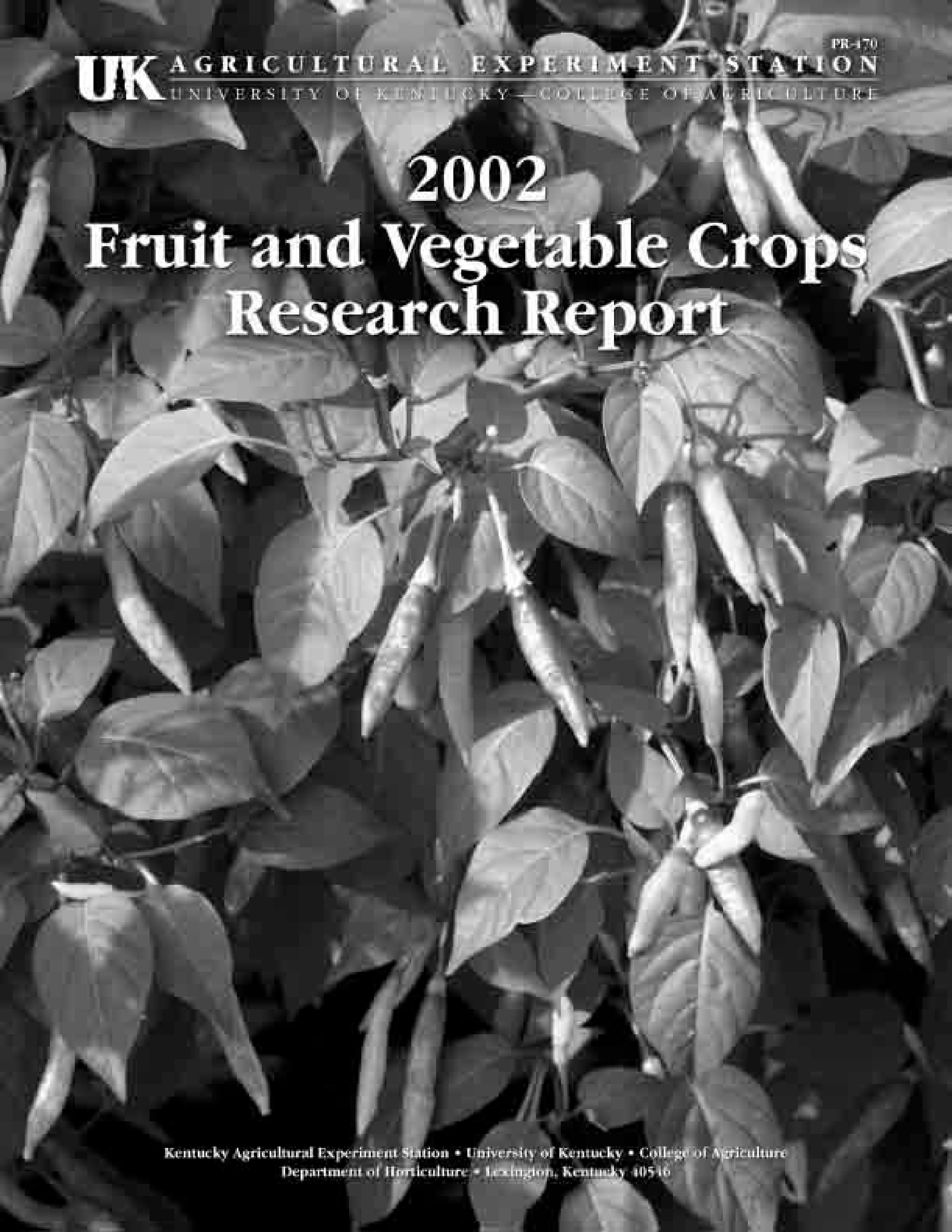
UK AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF KENTUCKY—COLLEGE OF AGRICULTURE

2002 Fruit and Vegetable Crops Research Report



Kentucky Agricultural Experiment Station • University of Kentucky • College of Agriculture
Department of Horticulture • Lexington, Kentucky 40546

2002 Fruit and Vegetable Crops Research Report

Edited by Brent Rowell and John C. Snyder

Faculty, Staff, Student, and Grower Cooperators

South American pepper *Capsicum baccatum* is a relative of bell and hot peppers commonly grown in the U.S. *C. baccatum*, a diverse species with unique characteristics, may have high value when sold as ornamental plants or as culinary specialty products. One activity of the New Crops Opportunities Center at UK *(www.uky.edu/Ag/NewCrops)* is an evaluation of the economic potential of this species for Kentucky growers. A number of selections of *C. baccatum* were grown at the UK Horticulture Research Farm in 2002.

Photo: Brent Rowell

Horticulture

FACULTY

Jerry Brown
Terry Jones
Joseph Masabni
Brent Rowell
John Snyder
John Strang

AREA EXTENSION ASSOCIATES

Shane Bogle
Clint Hardy
Nathan Howell
Chris Smigell
Dave Spalding

HORTICULTURE FARM MANAGER

Darrell Slone

HORTICULTURE FARMS STAFF AND TECHNICAL STAFF

Charles Back
Larry Blandford
Sherri Dutton
June Johnston
Dave Lowry
Janet Pfeiffer
Kirk Ranta
April Satanek
William Turner
Dwight Wolfe

STUDENTS

Amanda Ferguson
Barry Duncil
Spencer Helsabeck

INTERNATIONAL STUDENT INTERNS

Witoon Jaiphong
Sopon Issaravut

Entomology

FACULTY

Ric Bessin

STUDENTS

Karen Friley
Md. Sufian Yek

Plant Pathology

FACULTY

John Hartman
William Nesmith

STUDENT

Claudia Cotton

PROFESSIONAL STAFF

Paul Bachi
Julie Beale

Agronomy

FACULTY

David Ditsch

Agricultural Economics

FACULTY

Tim Woods

PROFESSIONAL STAFF

Matt Ernst

Kentucky State University Community Research Service

FACULTY

Gary Cline

PROFESSIONAL STAFF

Tony Silvernail

Berea College Agriculture & Natural Resources Department

FACULTY

Sean Clark
Michael Panciera

STUDENT

Wendell Garnett

Extension Agents for Agriculture and Horticulture

Chris Clark
Michael Keen
Kevin Lyons
Greg Henson
Annette Meyer Heisdorffer
Diane Perkins
Darrell Simpson
Ricky Yeargan

Grower Cooperator

John Bell

Demonstration Grower/Cooperators

Carry Barrett
Gary Cecil
Cole and Katie Clark
Chad Davis
Kevin Evans
Ken Johnson
Danny Miller
Sammy Monroe
Stephen Noe
Ottie Pantle
Mark and Louis Robertson
Mike Williams

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 Service 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.

Contents

Getting the Most Out of Research Reports

Brent Rowell, Department of Horticulture

The *2002 Fruit and Vegetable Crops Research Report* includes results of 25 field research trials and market surveys that were conducted at five locations in Kentucky (see map, below). The research was conducted by faculty and staff from several departments within the University of Kentucky College of Agriculture, including Horticulture, Entomology, Plant Pathology, Agronomy, and Agricultural Economics. This report also includes collaborative research projects conducted with faculty and staff at Kentucky State University and Berea College. Most of these reports are of crop variety (cultivar) trials.

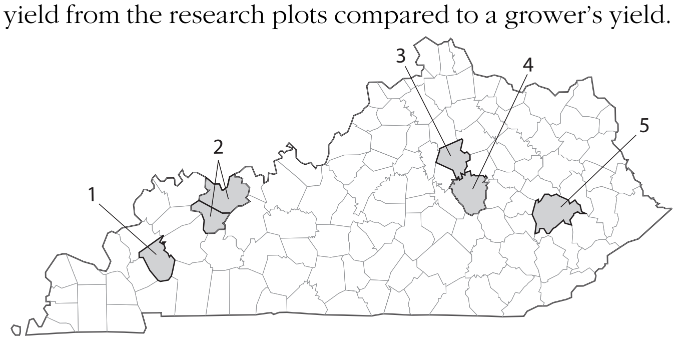
Growers usually put variety trials at the top of the list when rating projects at a public institution's research station. These trials provide a wealth of information not only to growers but also to County Extension Agents, researchers, and seed companies. The reports also provide us with much of the information we need in order to include varieties in our publication, *Vegetable Production Guide for Commercial Growers* (ID-36).

The main purpose of variety evaluation is to provide growers with practical information to assist them in selecting the most suitable variety for a given location or market. Below are some 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, our trial plot sizes range anywhere from 50 to 500 sq ft. Yields per acre are calculated by multiplying these small plot yields by correction factors ranging from 100 to 1,000.

These yields per acre may not be realistic, and small errors can be amplified when correction factors are used. For example, the calculations may overestimate yields because the plots harvested do not include empty spaces normally occupied by things such as drive rows in a grower's field. These empty spaces may result in a higher per-acre yield from the research plots compared to a grower's yield.



1. UK Research and Education Center, Princeton (Caldwell).
2. Daviess and McLean Counties.
3. UK Horticulture Research Farm, Lexington (Fayette).
4. Berea College Educational Farm (Madison).
5. Robinson Station, Quicksand (Breathitt).

In some cases research plots may be harvested more often than is economically feasible in a grower's field. So don't feel inadequate if our yields are higher than yours. You should be concerned, however, if our yields are *lower* than yours. In that case, there may be good reason to suspect that the trial was conducted improperly.

It is best not to compare the yield of a variety at one location to the yield of a different variety at another location. The differences in performance among all varieties grown at the same location, however, can and should be used to identify the best varieties for growers nearest that locality. Results vary widely from one location or geographical region to another; a variety may perform well in one location and poorly in another for many reasons. Different locations may have different climates, microclimates, soil types, fertility regimes, and pest problems. Different trials at different locations are also subject to differing management practices. Only a select few varieties seem to perform well over a wide range of environmental conditions, and these varieties usually become top sellers.

Climatic conditions obviously differ considerably from one season to the next, and it follows that some varieties perform well one year and perform poorly the next. For this reason we prefer to have at least two years of trial data before coming to any hard and fast conclusions about a variety's performance. In other cases, we may conduct a preliminary trial to eliminate the worst varieties and let growers make the final choices regarding the best varieties for their farm and market conditions (see Rapid Action Cultivar Evaluation [RACE] trial description on page 7).

Making Sense of Statistics

Most trial results use statistical techniques to determine if there are any real (vs. accidental) differences in performance among varieties or treatments. Statistical jargon is often a source of confusion, and we hope this discussion will help. In many cases, our trials are replicated, which simply means that instead of taking data from only one plot from one spot in the trial field, we plant that variety (or repeat the spray or fertilizer treatments) in other small plots in several spots in a field. If we test 20 pepper varieties, for example, we will have a small plot for each variety (20 separate plots), and then repeat this planting in two or three additional sets of 20 plots in the same trial field. These repeated sets of the same varieties are called replications, or blocks. The result is a trial field with 20 varieties x 4 replications = 80 small plots. The yield for a variety is reported as the average (also called the *mean*) of yields from the four separate small plots of that variety. The average per-acre yields reported in the tables are calculated by multiplying these average small plot yields by a correction factor.

Table A.

Yields, gross returns, and appearance of bell pepper cultivars under bacterial spot-free conditions in Lexington, Ky.; yield and returns data are means of four replications.

Cultivar	Seed source	Tot. mkt. yield[1] (tons/A)	% XL +Large[2]	Income[3] ($/acre)	Shape unif.[4]	Overall appear.[5]	No. lobes[6]	Fruit color	Comments
X3R Aristotle	S	25.0	89	10,180	4	7	3	dk green	most fruits longer than wide
King Arthur	S	22.5	88	9,079	3	5	4	light-med green	deep blossom-end cavities
4 Star	RG	22.2	86	9,111	3.5	6	4	light-med green	
Boynton Bell	HM	21.7	92	9,003	3	5	3	med-dk green	~15% of fruits 2-lobed (pointed)
Corvette	S	20.6	88	8,407	3	6	3&4	med-dk green	~10% elongated (2-lobed)
X3R Red Knight	S	20.5	90	8,428	3	5	4	med-dk green	
SP 6112	SW	20.2	78	8,087	4	6	3	med green	
Conquest	HM	20.0	85	8,021	2	5	3&4	light-med green	deep stem-end cavities, many misshapes
Orion	EZ	20.0	93	8,219	4	6	4	med-dk green	
Lexington	S	19.8	87	8,022	3.5	6	3	dk green	
PR99Y-3	PR	19.5	87	7,947	3	5	3&4	med green	many misshapen fruits
Defiance	S	18.7	87	7,568	4	7	3&4	dk green	
X3R Ironsides	S	18.4	92	7,585	4	6	3	med green	~5% w/deep stem-end cavities
X3R Wizard	S	18.0	92	7,447	3	6	3&4	dk green	
RPP 9430	RG	17.3	89	7,029	3	6	4	med-dk green	~10% of fruits elongated
ACX 209	AC	17.2	89	7,035	3.5	6	3	med green	
Waller-Duncan LSD (P<0.05)		5.2	7	2,133					

1 Total marketable yield included yields of U.S. Fancy and No. 1 fruits of medium (>2.5 in. diameter) size and larger plus misshapen but sound fruit which could be sold as "choppers" to foodservice buyers.

2 Percentage of total yield that was extra-large (>3.5 in. diameter) and large (>3 in. diameter but 3.5 in. diam.).

3 Income = gross returns per acre; average 2000 season local wholesale prices were multiplied by yields from different size/grade categories: $0.21/lb for extra-large and large, $0.16/lb for mediums, and $0.13/lb for "choppers," i.e. misshapen fruits.

4 Average visual uniformity of fruit shape where 1 = least uniform, 5 = completely uniform.

5 Visual fruit appearance rating where 1 = worst, 9 = best, taking into account overall attractiveness, shape, smoothness, degree of flattening, color, and shape uniformity; all fruits from all four replications observed at the second harvest (July 19).

6 3&4 = about half and half 3- and 4-lobed; 3 = mostly 3-lobed; 4 = mostly 4-lobed.

In most reports, we list the results in tables with varieties ranked from highest to lowest yielding (see Table A). Small differences in yield are often of little importance, and it is sometimes difficult to separate differences due to chance or error from actual differences in performance of varieties. The last line at the bottom of most data tables will usually contain a number that is labeled *LSD*, or *Waller-Duncan LSD*. LSD is a statistical measure that stands for "Least Significant Difference."

The LSD is the minimum yield difference that is required between two varieties before we can conclude that one actually performed better than the other. This number enables us to separate real differences among the varieties from chance differences. When the difference in yields of two varieties is less than the LSD value, we can't say with any certainty that there's any real yield difference. In other words, we conclude that the yields are the same. For example, in Table A cited above, variety X3R Aristotle yielded 25 tons per acre and Boynton Bell yielded 21.7 tons per acre. Since the difference in their yields (25 - 21.7 = 3.3 tons per acre) is less than the LSD value of 5.2 tons per acre, there was no real difference between these two yields. The difference between X3R Aristotle and X3R Wizard (25 - 18 = 7), however, is greater than the LSD, indicating that the difference between the yields of these two varieties is real.

Sometimes these calculations have already been made, and statistical comparisons among varieties are indicated by one or more letters (a, b, c, or A, B, C, etc.) listed after the yields in the tables (see Table B). If yields of two varieties are followed by one or more of the same letters, they are considered to be the same (statistically speaking, that is). Yields of two varieties are different if they have no letters in common. In this example, the average muskmelon fruit weight of Eclipse and that of Vienna are both followed by an "a," so they are not different, while values for Eclipse and Athena have no letters in common, indicating that the difference between them is real (that is, statistically significant).

What is most important to growers is to identify the best varieties in a trial. What we usually recommend is that you identify a group of best performing varieties rather

Table B.

Yields and quality of muskmelon cultivars at Quicksand, Ky., 2001; data are means of 4 replications.

Cultivar	Avg wt/ fruit[1] (lb)	Fruit/A[1]	Pounds/A	Rind thickness (mm)	% Soluble solids	**Comments** *(shape and appearance)*
Eclipse	8.8 a	5,601 ab	49,036	7.0	11.5	nice
Odyssey	8.8 a	6,016 ab	53,039	-	9.0	nice, elongated
Vienna	9.0 a	5,083 b	46,230	-	8.6	nice, plts showed MO deficiency
RAL 8793VP	8.7 a	5,601 ab	48,735	-	10.2	nice, good flesh color
Athena	6.4 b	6,846 a	43,440	2.6	8.8	small looking
Minerva	9.7 a	4,771 b	45,349	3.4	13.5	nice, melon chosen by customers first
LSD (P = 0.05)	1.5	1,636	ns			

1 Means followed by the same letter are not significantly different.

than a single variety. This is easily accomplished for yields by subtracting the LSD from the yield of the top-yielding variety in the trial. Varieties in the table having yields equal to or greater than the result of this calculation will belong in the group of highest yielding varieties. If we take the highest yielding pepper variety, X3R Aristotle, in Table A and subtract the LSD from its yield (25 - 5.2 = 19.8), this means that any variety yielding 19.8 tons per acre or more will not be statistically different from X3R Aristotle. The group of highest yielding varieties in this case will include the 10 varieties from X3R Aristotle down the column through variety Lexington.

In some cases, there may be a large difference between the yields of two varieties, but this difference is not real (not statistically significant) according to the statistical procedure used. Such a difference can be due to chance, but often it occurs if there is a lot of variability in the trial. An insect infestation, for example, could affect only those varieties nearest the field's edge where the infestation began.

It is also true that our customary standard for declaring a statistically significant difference is quite high, or stringent. Most of the trial reports use a standard of 95% probability (expressed in the tables together with the LSD as $P < 0.05$ or $P = 0.05$). This means that there is a 95% probability that the difference between two yields is real and not due to chance or error. When many varieties are compared (as in the pepper example above), the differences between yields of two varieties must often be quite large before we can conclude that they are really different.

After the group of highest yielding, or in some cases, highest income,[1] varieties (see Table A cited above) has been identified, growers should select varieties within this group that have the best fruit quality (often the primary consideration), best disease resistance, or other desirable trait for the particular farm environment and market outlet. One or more of these varieties can then be grown on a trial basis on your farm using your cultural practices.

Producers should also ask around to find out if other growers have had experience with the varieties in question. Growers who belong to a marketing cooperative should first ask the co-op manager about varieties because in some cases buyers have specified the variety to be grown and packed by the co-op. *Good marketing plans start with the customer's (market) requirements and work backwards to determine variety and production practices.*

RACE Trials

In cases where there are too many new varieties to test economically or when we suspect that some varieties will likely perform poorly in Kentucky, we may decide to grow each variety in only a single plot for observation. In this case, we cannot make any statistical comparisons but can use the information obtained to eliminate the worst varieties from further testing. We can often save a lot of time and money in the process. We can also provide useful preliminary information to growers who want to try some of these varieties in their own fields.

Since there are so many new marketing opportunities these days for such a wide variety of specialty crops, we have decided that this single-plot approach for varieties unlikely to perform well in Kentucky is better than providing no information at all. We hope that RACE trials, described on page 7, will help fill a need and best use limited resources at the research farms. See the 2000 and 2001 hot and specialty pepper reports for examples of such trials.

Hybrid vs. Open Pollinated

In general, hybrid varieties (also referred to as F1) mature earlier and produce a more uniform crop. They often have improved horticultural qualities as well as tolerance and/or resistance to diseases. Hybrid seed is usually more expensive than is seed of open-pollinated (OP) varieties. With hybrid varieties, seeds cannot be collected and saved for planting next year's crop. Hybrid seed is now available for most vegetable crops that are grown in the United States.

Despite the advantages of hybrids, there are some crops for which few hybrids have been developed (poblano pep-

[1] It is often desirable to calculate a gross "income" or gross return variable for vegetable crop varieties that will receive different market prices based on pack-out of different fruit sizes and grades (bell peppers, tomatoes, cucumbers). In these cases, yields in each size class/grade are multiplied by their respective wholesale market prices to determine gross returns (= income) for each cultivar in the trial.

pers, for example) or for which hybrids offer no particular advantages (most bean varieties). Interest in OP varieties has resurged among home gardeners and market gardeners who wish to save their own seed or who want to grow heirloom varieties for which only OP seed is available. Lower prices for produce in traditional wholesale market channels, however, may dictate that growers use hybrids to obtain the highest possible yields and product uniformity. Selecting a hybrid variety as a component in a package of improved cultural practices is often the first step toward improved crop quality and uniformity.

Where to Get Seeds

A seed source is listed for each variety reported in the trials. Seed source abbreviations with company names and addresses are found in Appendix A at the end of this publication. Because seeds are alive, their performance and germination rate depend on how old they are, where and how they were produced, and how they have been handled and stored. It is always preferable to purchase certified, disease-free seeds from a reputable seed dealer and to ask about treatments available for prevention of seed-borne diseases.

Many factors are considered when making a final choice of variety, including type, fruit quality, resistance or tolerance to pests, how early the variety is harvested, and cost. Keep in mind that some varieties may perform differently than in our trials, especially under different management systems. Producers should test varieties for themselves by trying two to three varieties on a small scale before making a large planting of a single variety. This method will be the best means of determining how well suited a particular variety is for your farm and market.

Variety Information Online

This publication is available online at *www.ca.uky.edu/agc/pubs/pr/pr470/pr470.htm*. Other useful sources of information for commercial vegetable growers can be found by following the links at *www.uky.edu/Agriculture/Horticulture/veglinks.htm*. In addition, results of some pepper and blackberry trials will are posted on UK's New Crops Opportunities Center Web site under current research at *www.uky.edu/Ag/NewCrops*.

Auburn University publishes a variety trial report twice a year in cooperation with several other universities. The 2001 reports have been posted in PDF (Acrobat) format at *www.ag.auburn.edu/aaes/information/publications/fruitsnutsvegs.html*.

Rapid Action Cultivar Evaluation (RACE) trials are:

- a means of getting new information to growers in the least amount of time.
- a cultivar (variety) or cultural practice trial without replication or with a maximum of two replications.
- trials in which preferably the same set of cultivars can be replicated by location—Lexington and Quicksand stations, for example. Cultivars can be grown on station and/or in growers' fields.
- trials that can be applied to vegetables, small fruits, herbs, cut flowers, or other annual ornamentals.
- appropriate for new crops for which the market potential is unknown or, in some cases, for existing crops with niche market potential.
- appropriate for screening a large number of cultivars (not breeding lines) of unknown adaptation.
- appropriate for home garden cultivars (expensive replicated trials are not appropriate for home garden cultivars in most cases).
- a means of addressing new questions about specialty crops without compromising replicated trials of priority crops.
- a good demonstration site for growers to get a general idea of cultivar's performance.

How do RACE trials differ from "observation trials" conducted in the past?

- RACE trials are planted on the best and most uniform plot ground and are well maintained, sprayed, irrigated, etc. They do not serve as guard rows in other replicated trials.
- Crops are harvested at the appropriate time, with accurate record keeping, yield data, and quality information. Results are reported/published, as are replicated trial results.
- Whenever possible, products are evaluated with assistance from knowledgeable marketers, interested produce buyers, and growers.
- Information obtained should not be used to identify one or two best cultivars but to eliminate the worst from further testing and make recommendations about a group of cultivars that can be put into further trials by growers themselves.

Fruit and Vegetable Program Overview

Dewayne Ingram, Chair, Department of Horticulture

The faculty, staff, and students in UK's vegetable and fruit programs are pleased to offer this 2002 Research Report. This is one way we share information generated from a coordinated research program in the College of Agriculture. We focus multi-disciplinary teams of faculty, staff, and students on the complex needs and opportunities facing fruit and vegetable crop production and marketing systems. Such a comprehensive mission is unique to land-grant universities. The research areas on which we have concentrated reflect stated industry needs, expertise available at UK, and the nature of research programs in neighboring states and around the world generating information applicable to Kentucky. If you have questions and/or suggestions about a particular research project, please do not hesitate to contact us.

Although the purpose of this publication is to report research results, we have included some highlights of our Extension program and undergraduate and graduate degree programs this year that are addressing the needs of the fruit and vegetable industries.

Extension Highlights

Our statewide and area educational conferences and seminars are probably the most visible activities of our Extension programs targeted to Kentucky's fruit and vegetable industries. Publications, videos, slide sets, newsletters, articles in state and national industry magazines, newspaper articles, radio spots, and television programs are also important, visible elements of our Extension program. However, we are also engaged in a wide range of less visible, but vital activities. More subtle activities include training for County Extension Agents so they can more effectively serve our clientele, the Plant Disease Diagnostic Clinic, soil testing and interpretative services, and diagnosis and problem-solving services.

Although there are many facets to the Extension program conducted by the team of subject-matter specialists and County Extension Agents, program expansion provided through a Kentucky Horticulture Council grant from the Agriculture Development Board (tobacco settlement) funds is highlighted this year. A significant portion of the initial grant has been invested to support expanded acreage of vegetables required by the new produce marketing cooperatives. These funds allowed us to hire six Extension Associates to work with faculty and County Extension Agents to conduct on-farm demonstrations and on-farm consultation. Five of these were focused on vegetable and fruit production/marketing. Thanks to a lot of advance work by the faculty and cooperating agents/growers, the Extension Associates hit the ground running. Special appreciation is given to Horticulture faculty Drs. Brent Rowell, Win Dunwell. and John Strang and County Extension Agents Annette M. Heisdorffer and Chris Clark. The five Extension Associates are:

- Shane Bogle (vegetables and fruits; located at the UK Research and Education Center in Princeton)
- Clint Hardy* (vegetables; working from the Daviess County Extension Office)
- Nathan Howell (vegetables; working from the Hart County Extension Office)
- Chris Smigell (fruits and vegetables; located at the UK campus in Lexington)
- David Spalding (vegetables; located at the UK campus in Lexington)

Collectively, this group of Extension Associates, working with faculty, County Extension Agents, and farmers, have completed 19 on-farm commercial vegetable demonstration plots and conducted 27 field days and farm tours at these sites involving 700 farmers and 45 county agents. Two grape-pruning demonstrations were established. In addition, more than 350 farm visits were conducted by these five Extension Associates. This grant also funded an expansion of on-station research plots with commercial vegetable and fruit crops, the results of which are found in the following pages of this report.

Undergraduate Program Highlights

The department offers areas of emphasis in Horticultural Enterprise Management and Horticultural Science within a Plant and Soil Science Bachelor of Science degree. Following are a few highlights of our undergraduate program in 2001-02:

- The Plant and Soil Science degree program had nearly 100 students in the fall semester of 2001, of whom almost one-half are horticulture students and another one-third turfgrass students. Eleven horticulture students graduated in 2001.
- We believe that a significant portion of an undergraduate education in horticulture must come outside the classroom. In addition to the local activities of the Horticulture Club and field trips during course laboratories, students have excellent off-campus learning experiences. Here are the highlights of such opportunities in 2002.
    - An 18-day study tour of Belgium, France, Germany, Great Britain, and the Netherlands was led by Drs. McNiel and Dunwell involving 14 students.
    - A one-week study tour of horticulture enterprises in Washington and Oregon was led by Drs. McNiel, Dunwell, and Geneve involving 10 students.

**This position is currently vacant as Clint has accepted the position of Daviess County Extension Agent for Agriculture and Natural Resources.*

- Horticulture students competed in the 2001 Associated Landscape Contractors of America (ALCA) Career Day competition at Illinois Central College in March (Drs. Robert McNiel and Mark Williams, faculty advisors).
- Students accompanied faculty to the following regional/national/international meetings, including the American Society for Horticultural Science Annual Conference, annual meetings of the Kentucky Vegetable Growers Association and Kentucky Horticulture Society, the Kentucky Landscape Industries Conference and Trade Show, the Southern Nursery Association Trade Show, the Green Industry Conference, and the International Horticultural Congress in Toronto.

Graduate Program Highlights

The demand for graduates with M.S. or Ph.D. degrees related to Horticulture, Entomology, Plant Pathology, and Agricultural Economics is high. Our M.S. graduates are being employed in the industry, Cooperative Extension, secondary and postsecondary education, and governmental agencies. Last year, there were 10 graduate students in these degree programs conducting research related to fruit and/or vegetable crops.

Graduate students are active participants in the UK research program in fruit and vegetable crops and contribute significantly to our ability to address problems and opportunities important to Kentucky's industry. Two new graduate students began work for advanced degrees focused on vegetable crops in 2002: **Amanda Ferguson** recently began her work at the Horticulture Research Farm on high tunnels for winter greens production. **Karen Friley** (co-advised by faculty from Horticulture and Entomology) is examining the feasibility of biological insect control in bell peppers (see her report in this volume). **Gayatri Patel** completed her M.S. degree with George Antonious (Kentucky State University) and John Snyder on soil residues of organic pest control materials. Other graduate students are working on post-harvest problems in fruit crops. Graduate students presented research results at the Kentucky Fruit and Vegetable Annual Meeting and at regional and national horticulture conferences.

The Robert E. McNiel Endowment

In the early 80s, the Horticulture Department realized that many of our graduates lacked exposure to the range of horticulture practices outside Kentucky. The faculty made a commitment to provide at least one study tour opportunity per year to our students. Fulfillment of that commitment has primarily been through Dr. Robert McNiel, often covering his travel expenses personally. He has led educational tours of industries and gardens throughout Kentucky, the United States, Europe, New Zealand, and China.

The Robert E. McNiel Horticulture Enrichment Fund is being endowed to honor Dr. McNiel and to provide support for faculty and student travel on our study tours. Dr. McNiel will be retiring within the next five years, and this is our opportunity to support future students wishing to participate in educational tours and activities. These study tours allow students to compare technology development at leading horticultural sites and research centers with application to horticulture in Kentucky and to determine the applicability of this technology to Kentucky's horticultural industries.

We are taking advantage of a unique opportunity through Kentucky's Research Challenge Trust Fund (RCTF). Any gift to this fund, or pledge made for payment over a five-year period, will be matched on a dollar-for-dollar basis. However, in order to be eligible for the match, we must have a minimum of $50,000 in gifts and/or pledges. As a result of UK's hosting of the Associated Landscape Contractors of America (ALCA) Student Career Days in 1999, there is a balance of $25,000, which ALCA has endorsed using for this effort. Therefore, we must raise $25,000 to match the $25,000 we already have in order to gain the RCTF match to create a permanent endowment of $100,000.

Reaching the $50,000 level is crucial, or we lose the $50,000 RCTF match. We need your help. Please consider the opportunity to provide lasting support of our students and their education. Additional information is available by contacting me in the Horticulture Department (859-257-1601) or by calling the College of Agriculture Development Office (859-257-7200).

Horticulture Research Farm

This year saw a significant increase in the participation of students in the summer field work at the Horticulture Research Farm (South Farm). Farm Manager **Darrell Slone** is to be congratulated for putting together a truly diverse, hard-working team that not only worked well together but also learned a lot in the process. These young men and women included Horticulture students and students from several other departments at UK. The group also included two special agricultural interns from Kasetsart University in Thailand, as well as students from Japan, Canada, and England. The Thai students returned to their country with a new knowledge and appreciation of agricultural research as well as some practical experience using drip irrigation.

The year also saw the completion of a master plan for the transformation of the "South Farm" to the **UK Horticultural Research and Education Center**. The plan, developed by Landscape Architecture professor Tom Nieman and Horticulture faculty Brent Rowell, focuses on the irreplaceable land resource of the "South Farm" and seeks to make it a permanent facility for horticultural research and education serving Kentucky farm families. The plan involves putting a new face on the farm with things like burial of power lines, new signage, and road improvements together with a new research and education center building. The plan also includes needed improvements in research infrastructure such as new greenhouses and expansion of coolers and facilities for post-harvest research. Portions of the plan will be accomplished through funds from the grant to the Kentucky Horticulture Council from the Agriculture Development Board.

2001/02 Kentucky Produce Marketing Practices Survey

Matt Ernst and Tim Woods, Department of Agricultural Economics

Introduction

The 2001/02 Kentucky Produce Marketing Practices Survey was conducted as part of an effort to summarize the condition of the produce industry in the southeastern United States. The survey also represents the most comprehensive effort to date to analyze the marketing practices adopted among Kentucky fruit and vegetable producers. It also provided the most current information available at the beginning of 2002 about planting trends and intentions among Kentucky fruit and vegetable producers.

Methodology

The Kentucky Produce Marketing Practices Survey was conducted in November and December of 2001 to collect 2002 planting intentions and 2001 marketing activity. During those months, 955 surveys were mailed to fruit and vegetable producers in Kentucky. The mailing list was compiled from a number of different sources including county Extension offices, farmers' markets, producer groups, marketing cooperatives, and the Kentucky Department of Agriculture. Two weeks following the survey mailing, a follow-up postcard was mailed thanking the participants and reminding them to return the survey.

Slightly more than 40% (385) of the producer surveys were returned. Nearly 34% (323) of the total surveys mailed were available for analysis. The remaining surveys returned (62, or 6.4%) represented addresses where produce was not marketed in 2001.

Results and Discussion

Demographics (Age, Experience)

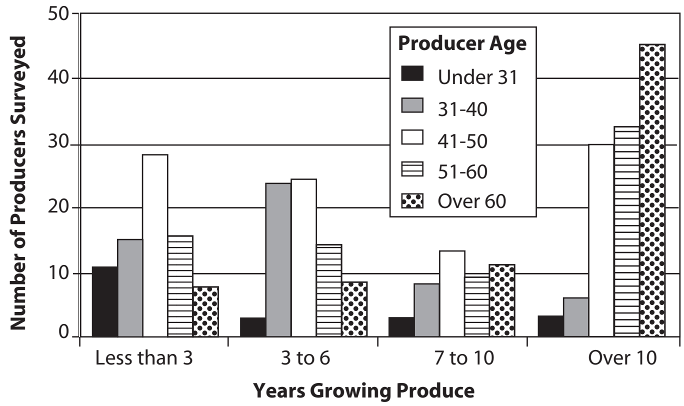
Many of Kentucky's fruit and vegetable producers are relatively new entrants into the industry. One-quarter of the respondents had been growing produce for less than three years, and almost half (48%) of the commercial fruit and vegetable growers surveyed had less than seven years' experience producing commercial fruits and/or vegetables.

Older producers made up the majority of the more experienced growers. Two-thirds (78) of the 117 producers with more than 10 years' experience growing fruits and vegetables were over 50 years of age. Only nine of the 117 producers with more than 10 years' experience were under 41 years of age (Figure 1).

Only a quarter (24%) of fruit and vegetable producers were under 40 years old. Almost half (145, or 46%) of the respondents were over 50 years old. Producers between 41 and 50 made up 31% of those surveyed.

The producers who responded to this survey operated a diversity of farms, from "super-gardens," to large commercial operations. Produce crops have often been touted as tobacco alternatives. Indeed, tobacco was the most common farm product produced alongside produce on operations surveyed (Table 1). This may indicate that efforts to recruit tobacco farmers for the Kentucky produce industry have been successful.

Figure 1. Fruit and vegetable producer age and experience.



Income

Of the 323 surveys available for analysis, 290 included responses categorizing both gross farm income and gross produce income. Each income category was broken down into four categories (under $20,000, $20,000 to $49,999, $50,000 to $99,999, and more than $100,000). The responses among these four broad categories indicate that produce sales comprise a minority of farm income, especially among producers with more than $20,000 in farm income.

Slightly more than one-quarter (27%) of those providing income information reported both farm and produce sales less than $20,000. These operations presumably rely on farm (and produce) incomes only to supplement outside incomes. Over one-third (36%) of those reporting gross farm income of more than $50,000 reported produce sales of less than $20,000. An additional 12% of those responding to the income questions reported gross farm income in excess of $100,000 and produce sales less than $50,000.

Future surveys may seek to more precisely gauge the percent contribution that produce sales make to gross farm income in Kentucky. The 2001 data, however, offer at least two generalizations. First, there is a significant portion of Kentucky's produce industry comprised of small, "hobby farms" or "super gardens." Second, produce sales contribute to no more than 50% of gross farm incomes among half (48%) of the farms surveyed. More detailed income questions would have been required to gauge the contribution of produce to farm incomes in the remaining 25% of respondents.

These demographic data show that produce in Kentucky is primarily grown as a supplement in households not relying on farm income for their livelihood or as a supplemental crop on relatively traditional farm operations. Recruitment of younger producers dedicated to produce crops as long-term, more primary means of income will be critical for continued expansion of Kentucky's produce industry.

Table 1. Other farm production.

	n	%
Tobacco	137	44%
Cattle and/or horses	117	37%
Row crops	101	32%
Hay	34	11%
Flowers	12	4%
Nursery/Greenhouse	5	2%
Other livestock	5	2%
Honey	3	1%

Table 2. Factors limiting expansion.

Factor	Score*
Prices received	3.25
Market outlets	3.24
Harvest labor availability	3.24
Cooling	2.85
Labor management	2.76
Weather	2.63
Other	2.46
Disease control	2.37
Irrigation	2.36
Labor housing	2.36
Insect control	2.19
Land	2.17
Equipment	2.12
Transportation	1.94
Credit availability	1.62

* 1 = not limiting, 5 = limiting

Acreage Expansion

Kentucky's produce acreage, especially vegetable acreage, has increased dramatically in the past four years. Vegetable producers surveyed indicated an anticipated acreage increase of 9% in 2002. Factoring in producers who did not respond to this survey and marketing co-op acreage reported in Kentucky, a 5% to 6% increase in Kentucky's total vegetable acreage was probably realized in 2002.

Responding fruit producers, who were not as widely represented in this survey, indicated an acreage increase of 4% in 2002. Fruit acreage was underrepresented in the survey, especially grape acreage. Since there is an expected increase in Kentucky vineyard acreage to 450 bearing acres by 2004, this will dramatically increase the growth rate in the fruit sector over the next few years.

Organic Expansion

The producers surveyed indicated that organic fruit and vegetable acreage is increasing at a faster rate than Kentucky's total produce acreage. Of the acres included in this survey, 2% (60 acres) were used for organic production. This represented one-third of Kentucky's 180 organic fruit and vegetable acres.

The organic producers surveyed indicated that they would be expanding their acreage by 30% in 2002. However, changes in the organic certification program delayed producers realizing this acreage increase. This delay, combined with additional interest being generated in organic fruits and vegetables, is expected to contribute to a significant increase in organic fruit and vegetable acreage in Kentucky during 2003.

Factors Affecting Expansion

Respondents were asked to rank 16 potential factors for limiting produce expansion on a scale of 1 to 5, with 1 being "not limiting" and 5 being "limiting." The leading factors for limiting expansion were prices received, market outlets, and harvest labor availability. Transportation and credit availability were cited as the least limiting factors (Table 2).

Respondents also ranked the importance of various factors in their decision process when considering a new crop to raise (Table 3). Interestingly, the top two factors (on average) both had to do with the direct buyer-seller connection: the buyer-seller relationship and meeting buyer standards. This reflects the importance of marketing viewed as both a limiting factor for expansion of existing produce crops and in considering a new crop.

Producers most often (78%) responded that they would ask other growers how to grow a new crop (Table 4). Closely behind other growers was the Extension Service, cited as a resource for information on how to grow a new crop by 71% of producers. Buyers were cited as the third most frequently consulted resource for growing a new crop, by 41% of producers.

Other farmers were also most frequently cited as a resource when marketing a new crop (57%). The Extension Service (42%) and buyers (41%) again followed other farmers.

The Kentucky Department of Agriculture has tried to maintain a very visible presence in the state, developing produce markets. However, among those producers surveyed, state and federal (FSA) programs were rated as being very little help to either production or marketing (Table 4). Overall, state department of agriculture marketing and regulatory plans were rated as being much less useful than university Extension agents.

In summary, producers considering either growing or marketing a new crop are most likely to obtain information from other growers or university sources. They view university Extension agents as much more useful in their operation than state department of agriculture marketing and regulatory programs. Continued research and support from university personnel is viewed by producers as a critical component in Kentucky produce industry expansion.

Table 3. Average importance of factors in considering a new crop.

Factor	Score*
Buyer-seller relationships	4.24
Meeting buyer standards	4.21
Market location	4.17
Transportation	3.50
Volume requirements	3.49
Grading	3.34
Cooling	3.30
Other	2.76
Contracting	2.68
Broker/Packer fees	2.58
Insurance	2.49

* 1 = not important; 5 = important

Table 4. Sources growers asked about growing/marketing a new crop.

Source	Growing	Marketing
Other growers	78%	57%
Extension	71%	42%
Buyers	41%	41%
Co-op	N/A	23%
Grower organization	36%	22%
KY Dept. of Ag	25%	17%
Internet	25%	N/A
Input suppliers	20%	7%
FSA	11%	N/A
Farm Bureau	4%	2%
No one	4%	8%

Marketing and connecting producers with markets continues to be the critical element in Kentucky's produce expansion. Expanding the amount of Kentucky-grown produce marketed to buyers whom producers trust and have a good relationship with will be critical to the expansion of Kentucky's produce industry. Efforts may also be needed in improving producer perception of the support provided by the State Department of Agriculture.

Marketing Channels

Producers use a variety of channels to market their produce (Table 5). The first most frequently utilized marketing channel is direct marketing, used by 78% of the 301 producers who responded to this question. The second most frequently utilized channel is cooperatives or marketing associations, used by 27% of the responding producers.

It is more likely that producers using co-ops will market all their produce through co-ops than those producers using direct marketing will market all their produce through direct channels. Among those producers using co-ops, 49% (39 of 80 producers) said that they used co-ops to market 100% of their produce. Among those who use direct marketing, 39% (91 of 235 producers) said that they used direct channels to market 100% of their produce.

This survey indicated that nearly 90% of producers use either direct markets or cooperative/marketing associations to market their produce. The remaining market channels—including direct to retail, wholesale, restaurant, grocer, Internet, processor, CSA, and auctions—account for only a small fraction of produce marketing in Kentucky.

Direct Marketing vs. Wholesaling

Comments throughout the surveys reflected an overall reluctance by direct marketers to be involved in wholesaling (Figure 2). Lower prices were cited by 54% of direct marketers as a barrier to wholesaling. Volume and quality requirements, as well as market availability, were also seen as barriers to wholesaling. Other barriers perceived by more than 10% of the respondents were labor and time requirements of wholesaling, as well as the buyer/seller relationships necessary in a wholesale market.

Only 19 of the 323 respondents (5.8%) said that they had transitioned from direct to wholesale markets. Six of these producers had started wholesaling because they had identified a new market, while five producers said that they had started wholesaling through a co-op. Six other producers said the market had just "come to them" or that they needed a way to move excess production. Only two of these 19 producers had shifted to wholesaling for profitability reasons.

Figure 2. Perceived barriers to wholesaling cited by direct marketers.

- Lower Prices 54%
- Volume/Quality Requirements 24%
- Availability of Markets 22%
- Labor/Time Requirements 17%
- Buyer/Seller Relationships 12%

Changes related to direct marketing were cited by 15% of the respondents as being in store for the 2002 year. These changes are frequently occurring as producers seek greater profits. Of the producers responding to the survey, one-third pay someone else a fee to sell their produce.

Produce handling and processing equipment is not often used on the farms represented by this survey. Only boxes were cited by more than half (57%) of respondents as being used. Sorting tables and washing equipment were used by 29% and 25% of the respondents, while retail packing and holding coolers were used by about one-fifth of those responding.

In order for Kentucky producers to expand wholesale production, profitable wholesale marketing agreements and good relationships with buyers will need to be established. Furthermore, post-harvest handling equipment is not common on Kentucky produce farms. Packing, grading, sorting, and harvesting efforts that combine the assets of a group of producers may therefore be critical to continuing wholesale market expansion in Kentucky.

Conclusion

The 2001 Produce Marketing Practices Survey showed that marketing, as well as recruitment and education of growers, continue to be the primary issues involved in expanding Kentucky's produce acreage. Significant expansion in Kentucky's organic produce industry is expected in 2003. However, without the development of adequate markets and infrastructure, produce expansion in Kentucky could slow in 2003 from the rapid growth rate witnessed in the past five years.

Table 5. Sales via specific market channels by number of producers responding.

	Percentage of Sales					
Market Channel	**0%**	**0-10%**	**10-25%**	**25-50%**	**50-99%**	**100%**
	Number of Producers					
Direct markets	66	11	29	19	85	91
Cooperative/Marketing association	221	1	9	10	21	39
Direct to retail market (grocery, etc.)	197	26	47	19	8	4
Wholesale (non-co-op) market	260	7	12	13	8	1
Direct to local restaurants	258	23	14	2	4	0
Shipper/Packer (sell to another grocer)	293	1	4	2	1	0
Internet	299	1	1	0	0	0
Processor	298	2	1	0	0	0
Community supported agriculture	286	2	6	2	3	2
Auctions	276	8	9	2	4	2

On-Farm Commercial Vegetable Demonstrations in Central Kentucky

Dave Spalding and Brent Rowell, Department of Horticulture

Introduction

Eight on-farm commercial vegetable demonstrations were conducted in Central Kentucky in 2002. Grower/cooperators were from Harrison, Marion, Nicholas, Scott and Woodford counties. There were two grower/cooperators from Harrison County: one grew 2 acres of bell peppers and the other grew 1 acre of slicing cucumbers with one-half trellised and the other half grown on the ground. Raised beds, black plastic, and drip irrigation were used in both plots of cucumbers. In Marion County, the grower/cooperator grew 1 acre of bell peppers on raised beds with plastic mulch and trickle irrigation and 0.5 acre of bell peppers on bare ground with overhead irrigation. The grower/cooperator in Nicholas County grew 1 acre of slicing cucumbers with one-half of the production trellised and one-half grown conventionally. In Scott County, there were two grower/cooperators, with one cooperator growing 1 acre of bell peppers and the other cooperator growing 1 acre of slicing cucumbers for the early season market and 1 acre of cucumbers for the late market. One-half of each planting was trellised and the other-half grown on the ground. The grower/cooperator in Woodford County grew 0.75 acres of mixed vegetables (tomatoes, peppers, squash, green beans, melons, cucumbers, and herbs) for the local farmers' market.

Materials and Methods

As in previous years, grower/cooperators were provided with black plastic mulch and drip irrigation lines for up to 1 acre and the use of the Horticulture Department's equipment for raised-bed preparation and transplanting. The cooperators supplied all other inputs, including labor and management of the crop. In addition to identifying and working closely with cooperators, County Extension Agents took soil samples from each plot and scheduled, promoted, and coordinated field days at each site. An Extension Associate made regular weekly visits to each plot to scout the crop and make appropriate recommendations.

The bell pepper demonstration plots were transplanted using three different bacterial spot-resistant varieties: Lexington, Enterprise, and Aristotle. Peppers were transplanted into 6-inch-high raised beds covered with black plastic and drip lines under the plastic in the center of the beds. Plants were transplanted 12 inches apart in an offset manner in double rows that were 15 inches apart. Raised beds were 6 ft from center to center. Plots were sprayed with the appropriate fungicides and insecticides on an as-needed basis, and cooperators were asked to follow the fertigation schedules provided.

The slicing cucumber plots were set up to look at trellising versus rowing of the vines on the ground as has been the conventional production practice. The plots were planted using the slicing cucumber variety Speedway. All cucumbers were transplanted into 6-inch-high raised beds covered with black plastic and drip lines under the plastic. Two plants were transplanted at 18-inch intervals in the center of each bed, and the beds were 6 ft apart. Half of each plot was trellised using stakes spaced 3 ft apart in the center of each bed with strings running from stake to stake at 6- to 8-inch intervals. There was also some experimenting with rows of stakes on each side of the bed 6 ft apart and arranged in an offset manner. The vines were trained to climb the strings as they grew in the trellised plots. Vines in the conventional plots were rowed to keep them on the plastic mulch. Plots were sprayed with the appropriate fungicides and insecticides on an as-needed basis, and cooperators were asked to follow the fertigation schedules provided.

Results and Discussion

The 2002 growing season was fairly typical for recent years in the Central Kentucky area, with the promise of an early spring interrupted by a frost on May 20. Most of the bell peppers survived the frost, but their development was set back by a few days. The slicing cucumbers did not fare as well, and most had to be replanted.

The grower/cooperators who grew bell peppers experienced an exceptionally good price year for their product. After the late-season frost, growing conditions were good for most growers in the area, and a number of growers had exceptionally good yields to go with very good prices. Among the grower/cooperators, one had problems with the timeliness of watering and keeping weeds under control, which substantially lowered the anticipated yield. Another had soil fertility problems that were not detected until it was too late to correct; those yields were also less than expected. The grower/cooperator in Marion County had better success with production on raised beds with plastic mulch and drip. This cooperator had more than four times the yield from the drip system compared to bare ground production (See Table 1). The Woodford County cooperator grew a mixture of crops for the local farmers' market and some area restaurants. Although this grower had been producing for these markets for a few years, this was the first time using raised beds with plastic mulch and drip irrigation. Production from essentially the same acreage this year was more than doubled that of last year. Returns were nearly triple those of last year, which had been considered a good year (Table 2).

Unfortunately, yields from the trellised and non-trellised cucumber plots could not be graded separately at the co-op and were not kept separate by the cooperators. Part of the

Table 1. Bell pepper costs and returns of grower/cooperators.

Inputs	Scott County (1 acre)	Harrison County (2 acres)	Marion County (1 acre)	Marion County (0.5 acre, bare ground)
Plants	$1,080.00	$1,600.00	$720.00	$390.00
Fertilizer	88.00	147.24	127.00	54.45
Black plastic	125.00	250.00	125.00	---------
Drip lines	140.00	280.00	140.00	---------
Fertilizer injector	55.00*	55.00*	55.00*	---------
Herbicide	---------	129.50	37.00	---------
Insecticide	84.00	460.00	102.00	51.00
Fungicide	46.50	116.28	22.13	11.06
Water	360.00** (170,000 gal)	564.00** (266,400 gal)	378.00** (186,000 gal)	104.00 (96,000 gal)
Labor	1,125.50# (384.0 hrs)	3,161.50*** (538.5 hrs.)	1,470.00*** (245.0 hrs.)	396.00*** (66.0 hrs.)
Machine	116.00 (22.0 hrs)	464.65 (88.0 hrs.)	211.20 (40.0 hrs.)	84.50 (16.0 hrs.)
Total expenses	3,220.00	7,228.42	3,387.33	1,091.01
Yield	10,110 lb	34,785 lb	31,785 lb	3,705 lb
Income	1,756.05	8,559.78	9,171.20	1,185.60
Net income (loss)	(1,463.95)	1,331.36	5,783.87	94.59
Net income (loss)/acre	**($1,463.95)**	**$665.68**	**$5,783.87**	**$189.18**
Dollar return/dollar input	0.55	1.18	2.71	1.09

* Costs amortized over 3 years.
** Includes the cost of fuel and 5-year amortization of irrigation system.
*** Does not include the cost of unpaid family and operator labor.
\# This was a school project that did not include pay for supervisor's time and labor.

problem was that cucumbers were harvested at a time when the grading line was busy with bell peppers. Without yield data, we have only anecdotal evidence regarding the benefits from trellising, and further research is required.

Slicing cucumber yields were good for both the trellised and conventional production methods, and prices were strong for both early- and late-season production. It was the grower/cooperators' impressions that for the early season, production and quality did not seem to be much different for trellised compared to conventional cucumber production. However, for late-season production, they thought that the trellised production method resulted in a much higher marketable yield than the conventional method and that the additional cost of trellising was offset by the higher marketable yields. In light of this year's experience, a more detailed evaluation of trellising is warranted.

Table 2. Grower/cooperator's costs and returns for mixed vegetables.

Inputs	Woodford County (0.75 acre)
Plants and Seeds	$1,566.00
Fertilizer	50.00
Black Plastic	93.75
Drip Lines	105.00
Fertilizer Injector	55.00*
Herbicide	20.00
Insecticide	50.00
Fungicide	---------
Water	560.00** (92,000 gal)
Labor	*** (1,680 hrs.)
Machine	591.36 (112.0 hrs.)
Total Expenses	3,091.11
Income	12,800.00
Net Income	9,708.89
Net Income (loss)/acre	**$12,945.19**
Dollar Return/Dollar Input	4.14

* Cost amortized over 3 years.
** Includes cost of water and 5 year amortization of irrigation system.
*** All labor was unpaid family labor and includes many hours spent at a farmer's market.

On-Farm Commercial Vegetable Demonstrations in South-Central Kentucky

Nathan Howell, Department of Horticulture

Introduction

Five on-farm commercial vegetable demonstrations were conducted in South-Central Kentucky in 2002. Grower/cooperators were located in Barren, Green, Hart, Logan, and Monroe counties; all participants were members of the Green River Produce Marketing Cooperative located in Horse Cave, Kentucky. The grower/cooperators in Barren and Monroe counties each grew approximately 1 acre of seeded and seedless watermelons. In Logan County, the cooperator grew 5 acres of cantaloupe, while the cooperator in Green County grew 2 acres of cantaloupes in a colored plastic mulch trial. The cooperator in Hart County, located on the Barren County line, produced approximately 1 acre of pumpkins with drip irrigation and 1 acre without drip irrigation. Each grower/cooperator came from a tobacco production background. This was the first year for each to grow each individual crop for commercial production in an effort to diversify farm operations.

Cooperators grew the Athena cantaloupe variety. Revolution seedless watermelon variety and Sangria and Sugar Baby seeded varieties were grown. Appalachian was used as the pumpkin variety. Cooperators marketed through the Green River Produce Marketing Cooperative and through local vendors.

Materials and Methods

Grower/cooperators were provided with 7,200 linear ft of black or green plastic mulch and drip irrigation lines (enough for 1 acre of harvested melons). Equipment for raised bed preparation and transplanting was provided by Green River Produce Marketing Cooperative for a nominal fee. Field preparation was followed by fertilizer application according to soil test results and recommendations provided by local fertilizer dealers and/or the University of Kentucky. Plastic for the cantaloupe and watermelon demonstrations was laid in late April and early May just a few weeks before transplanting. Weather conditions were very wet early in the season, making it difficult to lay plastic without wind damage and packed mud beds. The plastic was laid in rows with drip irrigation lines no longer than 500 ft and with 6 ft between bed centers; this allowed the producer to use the 7,200 linear ft of plastic on a 1½ acre plot. The drip irrigation systems used in the demonstrations used city water and groundwater. All cooperators provided their own transplants that they grew themselves or that were grown by greenhouse operators in the region.

The cantaloupe demonstrations (Table 1) were transplanted during the last two weeks of April and the first week of May with three- to four-week-old plants spaced 24 inches apart in the row. This resulted in a plant population of 3,600 plants per acre. Good stands of these high populations were reported. One cantaloupe demonstration also included a colored mulch trial: green infrared transmitting plastic was used to compare growth and yields to those from the traditional black plastic. Alternate rows were laid with black or green mulch so that an acre of green plastic and an acre of black plastic were used. Unfortunately, a very late killing frost in the region damaged approximately 75% of the crop, thereby ending the demonstration. Nevertheless, I did note that most of the surviving plants were on green plastic mulch. As a result of this observation, a study is planned for next year to look at the possibility of using green plastic mulch as protection against late freezes, which could possibly bring melons to market earlier.

After plants were established for the remaining cantaloupe demonstrations, insecticides were applied to prevent damage from cucumber beetles and other insects. Admire, Thiodan, and Pounce were used for cucumber beetle control. Admire was applied as a soil drench and was effective for about four weeks. Either Thiodan or Pounce was then used alternately on a weekly basis until harvest. Quadris and Bravo Weather Stik were applied weekly for disease control. The University of Kentucky's recommendations from *Vegetable Production Guide for Commercial Growers* (ID-36) were used for insecticides and fungicides. Plants were irrigated weekly or according to tensiometer readings. Seventy pounds per acre of calcium nitrate were fertigated each week.

Table 1. Muskmelon (cantaloupe) costs and returns, 2002.

Inputs	Logan County (5 acres)
Plants/Transplants	$1800.00
Fertilizer/Lime	424.00
Black plastic	608.00
Drip lines	543.00
Herbicides	335.00
Insecticides	1119.00
Fungicides	660.00
Pollination	320.00
Machine*	750.00
Irrigation/Water**	670.00
Labor***	3722.00
Freight to co-op	1313.00
Co-op 15% commission	3503.95
Box/Pallet fee	3603.15
Co-op membership	50.00
Harvest bin rental	360.00
Total expenses	19,781.10
Yield	29,677
Income co-op	23,359.70
Income non–co-op	2345.00
Net income (loss)	5923.60
Net income (loss)/acre	**$1184.72**
Dollar return/dollar input	1.30

* Machine rental, fuel and lube, repairs, and depreciation.
** Includes cost of fertilizer and 5-year amortization of irrigation system.
*** Includes hired labor and unpaid family labor.

Cantaloupe harvest began in early July and ran until the end of the month. Melons were harvested every day during that period. Melons were not harvested by the "slip" technique but by observing a subtle color change (referred to as the "breaker" stage when netting turns a little yellow, but skin color is still green).

The watermelon demonstrations (Table 2) were under the same extreme weather conditions as the cantaloupe trials. The Monroe County demonstration had extremely poor fruit set, possibly due to weather conditions in the region. The plastic was laid in rows no longer than 500 ft with 6 to 7 ft between centers using 7,200 linear ft of plastic on about 2 acres of land. Two- to three-week-old transplants grown by local greenhouse managers were transplanted to the field in mid- to late May at a spacing of 36 inches within the row. For adequate pollination of the seedless varieties, about one-third of the plants in the field were of a seeded variety. These seeded varieties were planted 10 days before the seedless variety and were placed in the outside rows and in every third row of the field thereafter. It was important to have a seeded variety with fruit that looked different from the seedless variety. This allowed them to be harvested separately for different markets.

After plants were established, insecticides were applied to prevent insect damage. Pounce and Thiodan were used alternately on a weekly rotation for cucumber beetle control. BravoWeather Stik and Quadris were also applied at 10- to 12-day intervals for disease control. UK's recommendations (*Vegetable Production Guide for Commercial Growers,* ID-36) were used for insecticides and fungicides. Plants were irrigated bi-weekly or according to readings from a Watermark® soil moisture meter. Seventy pounds per acre of calcium nitrate were fertigated each week after vines began to run.

Harvest began mid-August; each field was picked twice. Approximately 75% of the melons were harvested in the first week. Time of harvest for watermelons was determined by the dead tendril or curl method and by observing the yellowish undersides of the melons. These melons were harvested mid-August for sale to Kentucky school systems through the Kentucky Department of Agriculture's "Farm to School" program.

Plastic mulch was not used in the pumpkin demonstration; however, drip irrigation tape was placed down each row. Seeds were planted 3 ft apart in the row with rows 6 ft apart. One seed was planted per hill, about 1 inch deep. There was no benefit from drip irrigation in this planting this year. It rained almost every day after planting the pumpkins, and irrigation was not needed.

Pumpkins were planted in mid-June and sprayed on a weekly schedule with insecticides and fungicides. However, due to the extreme wet weather, diseases such as powdery mildew and fusarium fruit rot severely reduced yields. This was also the case in other parts of Kentucky in 2002 with a midsummer drought followed by very wet weather in much of the state. Harvest was in mid-September; only those pumpkins with good strong handles and a dark orange color were harvested (Table 3).

Results and Discussion

The 2002 growing season seemed abnormal during the early stages of plant growth. Extreme rains in early April prevented many producers from laying plastic mulch in a timely fashion. Once plastic mulch was down, cold, hard-packed soil led to poor growth. Many cooperators could not transplant into wet fields and were forced to transplant overmature plants. This may have resulted in reduced fruit set. A late killing frost also plagued cantaloupe producers in the region, and total losses were experienced by a couple of growers. After a normal mid-growing period, extremely wet and foggy weather fell on producers yet again in late summer. Many cucurbit plantings fell victim to downy mildew and other diseases four days to a week before harvest. These diseases defoliated the plants and left the fruit susceptible to sunburn.

Wholesale market prices for cantaloupe seemed to hold steady throughout the season at around 50 cents per fruit. With the addition of a new grading line and an upgrading of the cooler, together with regular classes for producers on proper growing and harvesting techniques, the Green River Produce Marketing Cooperative was able to ship nearly twice as many produce loads as last year and with few rejections. A new market for seedless watermelons through the "Farm to School" program, coordinated by the Kentucky Department of Agriculture, provided cooperators with an outstanding market at a price of nearly $7 for a two-pack case. The major issues facing some of the watermelon cooperators were conflicts regarding seedless and seeded varieties that were too similar to separate during harvest. It was very important to have distinct differences between seedless varieties and their seeded pollinators.

Table 2. Seeded/seedless watermelon costs and returns, 2002.

Inputs	Barren County (0.9 acre)	Monroe County (0.7 acre)
Plants/Transplants	$194.40	$341.65
Fertilizer/Lime	190.00	105.00
Black plastic	123.00	90.72
Drip lines*	117.60	85.68
Herbicides	26.00	33.00
Insecticides	114.00	49.00
Fungicides	100.00	70.00
Pollination	-------	-------
Machine**	255.00	25.00
Irrigation/Water	40.00	10.00
Labor***	161.00	150.00
Co-op 15% commission	596.40	-------
Box/Pallet fee	761.60	------
Co-op membership	50.00	50.00
Harvest bin rental	30.90	------
Total expenses	2759.90	1010.05
Yield (seeded)	200	90
Yield (seedless)	1120	245
Income co-op	3976.00	------
Income non–co-op	100.00	925.00
Net income (loss)	1316.10	(85.05)
Net income (loss)/acre	**$1462.00**	**($121.50)**
Dollar return/dollar input	1.48	0.92

* Includes irrigation drip tape fittings and flat tube poly.
** Machine rental, fuel and lube, repairs, and depreciation.
*** Includes hired labor and unpaid family labor.

Table 3. Pumpkin costs and returns, 2002.

Inputs	Barren County (2 acres)
Seed	$212.00
Fertilizer/Lime	------
Drip lines*	122.00
Herbicides	30.00
Insecticides	100.00
Fungicides	95.00
Pollination	------
Machine**	40.00
Irrigation/Water	50.00
Labor***	340.00
Co-op 15% commission	183.12
Box/Pallet fee	290.25
Co-op membership	50.00
Harvest wagon rental	50.00
Total expenses	1562.37
Yield	1750
Income co-op	1254.15
Income non–co-op	1000.00
Net income (loss)	691.78
Net Income (Loss)/acre	**$345.89**
Dollar return/dollar input	1.44

* Includes irrigation drip tape fittings and flat tube poly.
** Machine rental, fuel and lube, repairs, and depreciation.
*** Includes hired labor and unpaid family labor.

Overall, weeds seem to be the biggest concern for most growers. Some growers found that sowing rye grass between the beds of plastic was an excellent control strategy. Admire seemed to provide adequate control of cucumber beetles for three to four weeks after transplanting. Downy mildew was also a problem, even with weekly spray schedules. This problem led to sunburn and reduced marketable yields. Of the cooperators who grew for Green River Produce, those with positive returns indicated interest in producing vegetables on a commercial basis next year.

On-Farm Commercial Vegetable Demonstrations in Western Kentucky

Shane M. Bogle and Joseph G. Masabni, Department of Horticulture

Introduction

Three on-farm commercial vegetable demonstrations were conducted in Western Kentucky in order to attract tobacco growers to new opportunities such as commercial vegetable production. The grower/cooperators were located in Caldwell and Muhlenberg counties. In Caldwell County, one grower planted 0.7 acre of summer squash, and another grower planted 0.3 acre of cantaloupe. In Muhlenberg County, the grower/cooperator planted 0.6 acre of mixed vegetables (bell peppers, green beans, staked tomatoes, watermelons, cantaloupes, squash, and cucumbers). All growers came from a tobacco background and were looking for innovative ways to diversify their operation and supplement their tobacco income.

Materials and Methods

The growers were provided with black plastic mulch, drip irrigation lines, and the supervised use of UK Department of Horticulture field equipment for raised-bed preparation, mulch laying, and transplanting. Soil fertility was tested at the University of Kentucky Research and Education Center (UKREC), and fertilizer was applied according to soil test results and recommendations. The growers bought their own transplants and provided labor for pesticide sprays and crop harvests. Either well water or county water was used for drip irrigation at all three locations. The Extension Associate made weekly visits to each plot throughout the growing season to scout for diseases, address growers' concerns, and make recommendations. The County Extension Agents also worked closely with the growers. The agents were very helpful in scheduling, promoting, and coordinating field days at each location, during which the general public was invited to participate.

The squash demonstration plot was planted from seed with varieties Fortune, Liberator, Cougar, and Multipik. Raised-bed preparation, plant spacing, and drip irrigation installation were similar to that of tomatoes and according to UK recommendations in Extension publication, *Vegetable Production Guide for Commercial Growers* (ID-36). Black plastic was used on half the beds. while the other half was mulched with white (white on black) plastic.

The cantaloupe demonstration plot was transplanted with varieties Athena, Eclipse, Ambrosia, and Superstar Burpee. Cantaloupes were transplanted on 6-inch-high raised beds covered with black plastic mulch with drip lines under the plastic. Plants were spaced 24 inches apart in rows that were on 6-ft centers.

Two varieties of tomato, Mountain Delight and Better Boy, were transplanted on May 23. In-row spacing was 18 inches apart in 6-inch-high raised beds covered with black plastic with drip irrigation lines under the plastic. The raised beds were spaced 6 ft apart center to center. Tomatoes were staked and tied using the Florida weave system. The peppers were also transplanted into 6-inch-high raised beds spaced 6 ft apart center to center with plants spaced 12 inches apart in an offset manner in double rows 15 inches apart.

All plots were sprayed with appropriate fungicides and insecticides on an as-needed basis, and each cooperator followed a weekly fertigation schedule provided by the University of Kentucky.

Results and Discussion

The 2002 growing season was much like the previous two years, with a wet and cool spring followed by a hot, dry summer. Plastic was laid on the day of transplanting at all three locations with 100% plant survival through the first week.

The squash grower sold his entire crop through the Fairview Auction in Fairview, Kentucky, and was subject to major price fluctuations. In addition, sales receipts indicated no differences between squash plants grown on white or black plastic. The cantaloupe grower sold the majority of his crop to local grocery stores and the remainder at a local farmers' market. The grower who raised mixed vegetables sold his produce mostly through local farmers' markets and roadside stands, with some sales to grocery stores and restaurants. This grower was able to achieve very high returns. However, the data do not reflect the loss of more than 500 cantaloupes that could not be sold due to uneven ripening, attributed to poor varietal performance. Costs and returns data from the three demonstration plots are presented in Table 1. These data do not include marketing costs, a consideration when comparing these results to results from other demonstrations in which marketing costs may have been accounted for.

In general, the biggest concern experienced by all growers throughout the season was weed pressure between the rows of plastic. Moreover, as nighttime temperatures dropped and day-length shortened later in the season, tomato maturity slowed, and growers could not meet the market's demand of high-quality produce. With high disease and insect infestation due to the wet and cool spring, all three growers sprayed fungicides and insecticides frequently to keep insect and disease pressures at manageable levels. All three growers had positive experiences this year and plan to expand their operations next year. As a result, we plan to recruit more tobacco growers for next year.

Table 1. Costs and returns of three commercial vegetable demonstration plots in western Kentucky, 2002.

	Caldwell County		Muhlenberg County
Inputs	**Squash (0.7 acre)**	**Cantaloupe (0.3 acre)**	**Mixed Vegetables (0.62 acre)**
Plants	$87	$100	$717
Fertilizer/Lime	82	80	34
Black plastic	88	12.5	78
Drip lines	98	14.0	87
Fertilizer injector	88	200	170
Herbicide	-----	-----	9
Insecticide	52	100	84
Fungicide	29	50	100
Water	40 (42,000 gal)	-----[a]	500 (170,000 gal)
Labor[b]	200 (25 hr)	1,100 (110 hr)	2,200 (310 hr)
Machine	125 (12 hr)	100 (10 hr)	220 (12 hr)
Box fee	374	-----	308
Total expenses	1,263	1,757	4,507
Yield	559 boxes	2,900 melons	21,000 lb
Income	2,190[c]	3,150	7,800
Net income	927	1,394	3,293
Net income/acre	**$1,324**	**$4,647**	**$5,311**
Dollar return/ dollar input[d]	1.73	1.79	1.73

[a] Water from well at no cost to the grower, 50,000 gallons used; these costs of pumping, etc., have not been accounted for in this report.
[b] Includes hired labor and unpaid family labor.
[c] A 10% commission to the auction house is factored in.
[d] Dollar return/dollar input = Income/total expenses.

Blackberry Cultivar Evaluation, Eastern Kentucky

Charles T. Back, William Turner, and R. Terry Jones, Department of Horticulture

Introduction

Blackberry (*Rubus*), a native plant, grows well in Kentucky, and new improved blackberry cultivars offer a chance for crop diversification and a high income per acre crop for Kentucky agricultural producers. Blackberries have multiple uses including fresh or processed consumption, wine production, and medicinal purposes. *Rubus* has lower establishment and labor costs than many horticultural enterprises. It is also important to note that blackberries have the potential to be grown on hilly land and strip-mine sites and have a low erosion potential when grown in conjunction with sod strips. With available mechanization, blackberries may be grown on a large scale and mechanically harvested, or they may be grown on a small scale and hand-harvested for local fresh markets.

Materials and Methods

A thorny and thornless blackberry cultivars and advanced breeding selection trial was planted in a randomized complete block experimental design in May 2000 on raised beds. For the thorny cultivars, six plants/replication were planted 2 ft apart in the row. The thornless erect cultivars were planted with four plants/replication at a spacing of 3 ft. Plants of a thornless semi-erect cultivar (Triple Crown) were planted 4 ft apart in the row with three plants per replication. All rows were spaced 14 ft apart. There was a total of five replications with a 3-ft space between replications. The blackberries received a single application of 50 lb actual N/A from ammonium nitrate in March of 2001 and in 2002. The blackberries were evaluated for vigor, winter/spring hardiness, disease problems, as well as fruit yield, berry size, fruit appearance, and firmness.

Results

Many thorny and thornless blackberry cultivars have a tendency to de-harden and break dormancy early in Quicksand where 60° to 70°F in January and February are followed by 10° to 20°F in March and April. This weather pattern occurs at least once every four or five years and did so in 2002. Thornless cultivars such as Hull and Triple Crown, while considered less hardy than thorny blackberries, do very well here under our growing conditions because they are slow to break bud and remain dormant later into the spring. The year 2002 was a year of warm, sunny weather early and cold, overcast weather late in the season. Table 1 shows the bloom development and the presence of floricane injury in early May 2002. Canes showing injury at that time tended to die prior to harvest, reducing yield and berry quality. Once hot, dry weather came in June and July, a lot of floricanes were lost.

The three thorny blackberry cultivars tested are listed in Table 2. Kiowa produced the highest yield (7,185 lb/A) and had the least amount of visible cane injury. Unfortunately, Kiowa is very susceptible to a fungal disease called double blossom. In a warm humid climate,

Table 1. Percentage of full bloom and floricane injury of 12 blackberry cultivars and breeding selections evaluated on 4 May 2002 at Quicksand, Kentucky.

Cultivar/ Selection*	Percent Full Bloom	Degree of Floricane Injury	Comments
A1963	0	injured	3 of 5 replications injured
A1539	80	none	
A2049	48	injured	3 of 5 replications injured
A1857	37	injured	2 of 5 replications injured
A1854	98	injured	1of 5 replications injured
A1960	15	injured	4 of 5 replications injured
A1689	1	slightly injured	1 of 5 replications injured
A1905	6	none	
Navaho	1	severely injured	4 of 5 replications injured
Kiowa	5	none	double blossom
Shawnee	61	none	double blossom
Triple Crown	0	none	

* Selections preceded by an "A" and followed by a number are unreleased breeding selections and are not available in commerce at this time.

Table 2. Harvest start date, harvest duration, yield, fruit quality, and disease evaluation of three thorny blackberry cultivars and selections, Quicksand, 2002.

Cultivar/ Selection*	Harvest Start[1]	Harvest Days[2]	Yield (lb/A)	Fruit Size (oz)	Taste[3]	Appearance[4]	SS (%)[5]	Disease Rating[6]	Remarks
Kiowa	6/27	40	7185	0.32	T	A+	8.0	2.4	double blossom
A-1854	6/18	35	4052	0.12	ST	A	9.0	0.6	
Shawnee	6/20	36	4010	0.38	S	A	8.4	2.5	double blossom
LSD[7]			NS	NS					

* Selections preceded by an "A" and followed by a number are unreleased breeding selections and are not available in commerce at this time.
1 The first day of harvest for that cultivar.
2 The number of days between first and last harvest for each cultivar.
3 Taste of fresh fruit, T = tart, S = sweet, B = bland.
4 A- = below average; A+ = above average; A = average.
5 SS = soluble solids of fresh berries.
6 Disease ratings are on a 0 to 5 scale; 0 = no disease seen, 5 = 100% of plants have disease present.
7 Least significant difference at the 5% level.

it would be hard to raise Kiowa without having a good fungicide spray program. Kiowa also has a tendency to lay down on the job, and this makes picking and mowing difficult. A-1854 had tremendous fruit set, but the injured floricanes in all five replications slowly declined, resulting in small berry size. Shawnee was also subject to cane injury and had problems with double blossom. In past trials at Quicksand, Shawnee had problems with hardiness and disease and was included in this trial as a check for these problems.

The highest yielding thornless blackberry (Table 3) was Triple Crown (7,623 lb/A). The three cultivars A-1857, Navaho, and A-2049 all suffered severe floricane injury and did not produce well. The fruit from Navaho were so small and dried they were not marketable. The breeding selections A-1689 and A-1905 appeared to suffer less cane injury and produced attractive fruit. The fruit quality of these two selections made them the "pickers' choice" among all the blackberries harvested this past year. No disease symptoms were observed on any of the thornless blueberry cultivars. Additional tests are needed to determine the long-term suitability of any blackberry cultivar to our climatic conditions. Additional evaluations are planned for 2003.

Table 3. Harvest start date, harvest duration, yield, and fruit quality of nine thornless blackberry cultivars and selections, Quicksand, 2002.

Cultivar/ Selection*	Harvest Start[1]	Harvest Days[2]	Yield (lb/A)	Fruit Size (oz)	Taste[3]	Appearance[4]	SS (%)[5]	Remarks
Triple Crown	7/06	28	7623 A	0.193 A	S	A	10.0	
A1689	6/30	37	4793 A	0.188 B	S	A	9.3	
A1905	6/24	41	3472 BC	0.183 C	S	A+	10.2	
A1963	6/26	33	2165 CD	0.178 D	S	A+	8.3	
A1960	6/23	40	2103 CD	0.166 E	S	A+	9.9	
A1539	6/19	43	1873 DE	0.164 E	T	A+	9.2	
A1857	6/20	26	801 DEF	0.134 F	ST	A	10.9	uneven druplets
Navaho	6/26	23	537 EF	0.010 H	ST	A-	8.8	uneven druplets
A2049	6/21	28	452 F	0.119 G	ST	A-	10.5	
LSD[6]			1369	0.004				

* Selections preceded by an "A" and followed by a number are unreleased breeding selections, and are not available in commerce at this time.
1 The first day of harvest for that cultivar.
2 The number of days between first and last harvest for each cultivar.
3 Taste of fresh fruit, T = tart, S = sweet, B = bland.
4 A+ = above average; A- = below average; A = average.
5 SS = soluble solids of fresh berries.
6 Least significant difference at the 5% level.

Evaluation of Thornless Semi-Erect and Erect Blackberry Training Systems and Varieties for Kentucky

John Strang, April Satanek, John Snyder, Chris Smigell, Phillip Bush, Dave Lowry, and Darrell Slone, Department of Horticulture

Introduction

Blackberries continue to be a popular market item for Kentucky consumers, and most growers find that high quality blackberries are readily marketable. This study is being conducted as part of the New Crops Opportunities Fruit Project at the Horticultural Research Farm in Lexington, Kentucky. One portion of the study has been designed to evaluate two training systems for three thornless, semi-erect blackberry varieties using a double-T four wire trellis. The second portion of the study is to evaluate the use of a plastic bailing twine trellis for cane stabilization versus no trellis for two thornless, erect blackberry varieties.

Materials and Methods

Semi-erect thornless blackberry plants were set the spring of 2000 into black plastic-mulched beds. Each plot consisted of three plants of either Hull Thornless, Triple Crown, or Chester spaced 8 ft apart in the row with 12 ft between rows. Each plot was replicated three times in a randomized block design. All plants were trained on a double-T four-wire trellis with the lower two wires 2 ft apart and the top two wires 4 ft apart. Two training systems were used, a conventional system and the Oregon system.

In the conventional system, primocanes were topped when they had extended 1 ft above the top of the trellis. Dead fruiting canes that had cropped were removed in the fall. During early spring, dormant pruning, spindly canes, and/or those that had red-necked cane borer swellings were removed. Lateral branches were pruned back to 18 inches in length, and those that were within 18 inches of the ground were removed completely.

Primocanes were not summer tipped for the Oregon system. In the spring, canes were not thinned, although those with red-necked cane borer swellings were removed. Low laterals, within 18 inches of the ground, were removed.

Laterals above this were not cut back and were wound around, and sometimes loosely tied to the closest trellis wire, extending away from the plant.

Arapaho and Apache erect blackberry plants were set 3 ft apart in the guard rows on the north and south sides of the semi-erect blackberry plot. Trellising treatments (supported and unsupported) and varieties were each replicated three times in a completely randomized design. Plots consisted of three plants of the same blackberry variety. Metal fence posts were set at intervals of 9 ft, and plastic bailer twine was run on both sides of the supported treatment at a height of 3.5 ft.

During the first (2000) growing season, canes were allowed to trail and grow as much as possible. In the spring of 2001, the erect blackberry canes were pruned severely to encourage development of more vigorous shoots for the following season. During the summer of 2001 and 2002, primocanes were tipped at a height of about 3 ft. Spindly canes and those with red-necked cane borer swellings were removed in the spring of 2002. Laterals were cut back to a length of 16 to 18 inches.

The black plastic mulch was removed in the spring of 2001, and plants were watered by hand as needed. The summer of 2002 was dry, and a trickle irrigation system was installed. Plants were fertilized in February with calcium nitrate at the rate of 8 lb/100 ft row (43.5 lb N/A). Weeds were controlled by hand weeding, spot treatment with Roundup, and, in 2002, with Princep 4L. A conventional fungicide spray program using Kocide, captan, Nova, and Benlate was maintained. Japanese beetles and green June beetle pressure was severe in 2002, and both sevin and malathion were used for control. Bird pressure was also severe early in 2002, and an avian alarm was set up.

Plants were harvested in 2001 and 2002. Data were collected for yield, fruit size, and fruit soluble solids. The season in 2002 was hot and dry, which helped to elevate berry sugar content.

Results and Discussion

Statistical analysis was not conducted on the 2001 yield data (Table 1), but trends for berry weight and soluble solids (% sugar) content were similar to those obtained in 2002. Triple Crown tended to be the highest yielding and Hull Thornless the lowest yielding in 2001, while this was reversed in 2002 (Table 2), although there was no significant difference in yield. The fruit load in 2001 could have been responsible for the reversal in 2002. Arapaho and Apache had very low yields in 2001 due to the severe spring pruning.

In 2002, there were no significant differences in yield among the three semi-erect blackberry varieties (Table 2) or between training systems (Table 3). Triple Crown had a larger berry size than the other two varieties. Triple Crown berries also had a 1% higher soluble solids (sugar) content than Chester, which in turn had almost a 2% higher soluble solids content than Hull Thornless. The Triple Crown fruit were noticeably sweeter than the other berries. Pickers felt that Triple Crown had the most attractive-looking fruit.

Results for the erect blackberries can be found in Tables 4 and 5. Yields were higher for the plants supported by the string trellis for both varieties (Table 5), but there were no differences between training systems for average berry weight or soluble solids. Berry weight was higher for Arapaho as compared to Apache. This is contrary to the variety descriptions in the literature. There were no differences between varieties for yield or soluble solids (Table 4). Bird losses were more severe on the erect blackberries because these were the first to ripen. Pickers felt that of the two thornless erect blackberries, Apache had the more attractive fruit.

Table 1. Thornless blackberry yield, berry weight, and soluble solids level, 2001 harvest.

Variety	Avg. Yield (lb/plant)	Avg. Berry Wt. (g)	Soluble Solids (%)
Chester	13.0	5.2	7.6
Triple Crown	14.3	7.6	10.0
Hull Thornless	4.2	5.5	6.5
Arapaho[1]	1.3	5.3	12.0
Apache[1]	0.9	4.9	10.8

[1] The erect thornless blackberries were pruned severely the spring of 2001.

Table 2. Thornless semi-erect blackberry variety yield, average berry weight, and soluble solids, 2002 harvest.

Variety	Yield[1] (lb/A)	Avg. Berry Wt.[1] (g)	Soluble Solids[1] (%)
Chester	11,027 a	4.9 b	10.4 b
Hull Thornless	13,158 a	5.4 b	8.6 c
Triple Crown	10,150 a	7.5 a	11.4 a

[1] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05).

Table 3. Thornless semi-erect blackberry yield, average berry weight, and soluble solids based on training system, 2002 harvest.

Training System	Yield[1] (lb/A)	Avg. Berry Wt.[1] (g)	Soluble Solids[1] (%)
Conventional	10,805 a	6.1 a	10.0 a
Oregon system	12,085 a	5.8 a	10.2 a

[1] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05).

Table 4. Thornless erect blackberry variety yield, average berry weight, and soluble solids, 2002 harvest.

Variety	Yield[1] (lb/A)	Avg. Berry Wt.[1] (g)	Soluble Solids[1] (%)
Apache	3,818 a	5.2 b	10.3 a
Arapaho	4,821 a	6.5 a	11.0 a

[1] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05).

Table 5. Thornless erect blackberry yield, average berry weight, and soluble solids based on training system, 2002 harvest.

Training System	Yield[1] (lb/A)	Avg. Berry Wt.[1] (g)	Soluble Solids[1] (%)
No trellis	2,707 b	5.0 a	10.7 a
String trellis	5,932 a	6.7 a	10.7 a

[1] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05).

Kentucky Blueberry Markets Bursting— Consumer Survey Shows Continued Strong Demand

Matt Ernst and Tim Woods, Department of Agricultural Economics

Introduction

A consumer demand analysis was completed during the summer of 2002 on fresh blueberries grown in Kentucky. A very small acreage of blueberries (40 acres) is currently in production, but a number of producers are looking at expanding this enterprise. The demand analysis was conducted to provide market information on consumer willingness to pay for various container sizes. Consumers were evaluated in both a retail supermarket and a farmers' market. Product use, bulk purchase capacity, and interest in pick-your-own were also explored. According to this analysis, consumers in both small and big Kentucky towns are willing to pay well above the grower breakeven price for fresh, high-quality Kentucky blueberries in any size container.

Methodology

A random survey of 137 blueberry buyers was conducted during the first two weeks of Kentucky's blueberry season. Most of the surveys (112) were collected at the Lexington Farmers' Market. There were also 25 surveys collected in Metcalfe County at the "Blueberry Festival" promotion that featured locally grown blueberries in the Edmonton CB Foods grocery store.

The survey took less than two minutes to complete. It included questions about how much consumers were willing to pay that day for retail blueberries, what blueberries were being used for, whether the customer had freezer capacity, and how much customers would be willing to pay for U-Pick blueberries.

Results and Discussion

Lexington Farmers' Market customers surveyed indicated that they would be willing to pay an average of $3.14 per pint of blueberries in season (Table 1). Consumers at the Farmers' Market were accustomed to paying $3.00 per pint for fresh blueberries. Most farmers' market customers, though, said that they were willing to pay whatever the market price was for blueberries on any given day.

In Metcalfe County, some 150 miles southwest of Lexington, CB Foods featured local, handpicked blueberries for $1.88 per pint. CB Foods is a smaller retail grocer that agreed to feature local blueberries in their produce section. The consumers surveyed there on a Saturday indicated that they would be willing to pay, on average, $2.08 per pint of blueberries (Table 1).

Customers at both the Lexington Farmers' Market and the Metcalfe County grocery indicated that they would primarily use the blueberries purchased for fresh fruit or baking (Table 2). Customers in the more rural Metcalfe County, though, were more likely to have additional freezer capacity beyond a usual household refrigerator (Table 3).

Table 1. The MOST for blueberries that I would be willing to pay today.

	Lexington Average	Metcalfe County Average
½ pint is	$1.81	$1.17
1 pint is	$3.14	$2.08
1 quart is	$5.48	$3.83

Table 2. My primary use for the blueberries that I am purchasing today.

	Lexington	Metcalfe County
Baking (pies, muffins, etc.)	20%	50%
Fresh fruit (fruit salad, fresh ingredient)	88%	54%
Preserving (jam/jelly)	6%	8%
Other	2%	0%
Don't know yet	0%	0%

Table 3. I use a free-standing freezer (deep-freeze) in my home.

	Lexington	Metcalfe County
Yes	32%	85%
No	68%	15%

The additional amount that consumers would be willing to pay for a quart-size container of blueberries over the pint-size was observed to be largest in the farmers' market, an additional $2.34. This is 78% of the $3.00 price that customers were used to paying at the farmers' market. The supermarket customers, however, were willing to pay an additional 84%, or $3.83, of what they were used to paying per pint for a quart-size container of blueberries (Table 1).

Wholesale prices for local berries at both these markets were well within the $1.25 to $2.00 price per pint that Kentucky's blueberry farmers received in 2002. Blueberry enterprise budget estimates from the UK New Crop Opportunities Center show that blueberry growers can make adequate profits from blueberries at these wholesale price levels. Growers who are willing to market their own berries at "premium" markets (like the farmers' market) can expect to generate significantly greater profits. Farmers' markets offer consistently higher demand, but also have limited volume of product with fewer customers.

U-Pick Promise

Producers willing to tailor their production for U-Pick markets can often capture higher profits than wholesale producers. This is because U-Pick eliminates labor costs, the largest cost for wholesale blueberry production. In fact, according to university estimates, those willing to develop a U-Pick blueberry market in their area can make $800 to $1,500 more per acre over wholesale berry production when charging a price of $1.25 per pint.

The survey indicated that about half the consumers at both markets would be interested in picking their own berries at a nearby farm. Lexington Farmers' Market customers said that they would pay an average of $2.13 per pint for berries that they picked themselves (Table 4). Those surveyed at the Metcalfe County grocery indicated that they would be willing to pay considerably less, $1.24 per pint, for U-Pick blueberries (Table 4).

Interestingly, some of those surveyed at the Lexington Farmers' Market indicated that they would be willing to pay more than they were paying at the market just to go to a farm and pick their own berries. Therefore, enterprising farmers willing to provide a hospitable and entertaining environment for U-Pick berry customers may be able to capture additional profits.

Table 4. I would be interested in picking my own berries at a nearby farm.

	Lexington	Metcalfe County
Yes	58%	42%
No	42%	58%
$__/lb willing to pay for U-Pick	$2.13	$1.24

Conclusion

Kentucky's blueberry acreage has doubled to 40 acres since 1997 and is expected to double again to 80 acres by 2005. Statewide demand should easily support this acreage increase. Furthermore, this survey indicates that consumers appear to be willing to pay top price for fresh, high-quality Kentucky-grown blueberries. This consumer willingness to pay top price for blueberries should ensure adequate profits for those producers willing to invest the necessary time and capital into this "new" crop for Kentucky.

A complete report of this survey is available online at *www.uky.edu/ag/hortbiz.*

Blueberry Cultivar Trial—Eastern Kentucky

R. Terry Jones, William Turner, Charles T. Back, and David C. Ditsch, Departments of Horticulture and Agronomy

Introduction

Although blueberries are a native fruit crop, only limited commercial acreage has been established in Kentucky. Blueberries have an excellent potential for local sales and U-pick operations. Recent research into the health benefits of small fruits including blueberries may help increase sales even more. Vaccinium is increasing in popularity in the world of pharmaceuticals. As consumers become more conscious of the foods they eat, they may find themselves eating more blueberries. Scientists attribute the blueberry's healing powers to the flavonoid anthocyanin, which is responsible for the blue berry color found only in the peel. Anthocyanins and other flavonoids could help fight the development of cancer, cardiovascular disease, as well as eye problems such as glaucoma and poor night vision.

The high initial start-up costs for blueberries, approximately $4,000/A, is mainly due to land preparation, plant, and labor costs. However, after the plants reach maturity in approximately five years, the profits should steadily increase to as high as $6,000/A per year. Farmers must make planting decisions based on their own unique situation.

The longevity of a properly managed blueberry crop is similar to that of a well-managed apple orchard. Blueberries require acidic soils with a pH of 4.5 to 5.2, with good drainage and high organic matter. It is best to plant more than one cultivar to ensure good pollination and a continuous harvest of berries. Harvest usually begins in early June and lasts well into July.

Materials and Methods

Two blueberry plantings were established in the fall of 1996 at the University of Kentucky Robinson Station and the Laurel Fork Demonstration Site. Growth, yield, and survival of various blueberry cultivars were compared between a normal silt loam site and a disturbed mine site. The plantings consisted of 8 to 12 rows of various cultivars in a randomized block design. Plants were 4 ft apart in raised beds 14 ft apart. Drip irrigation with point source emitters (2 gph/plant) was installed shortly after planting. Plants were fertilized beginning in the spring of 1997. In 2002 one application 5-20-20 (5 lb/100 ft of row) was followed by two sidedressings of 5 lb ammonium sulfate/50 ft of row (at bloom and again two weeks latter). Netting was used at both sites to prevent loss due to birds.

Results

Twenty-one cultivars at Quicksand and 18 cultivars at Laurel Fork were tested, and results are shown in Tables 1 and 2, respectively. This year a cold, wet spring with freezes during bloom (April 6 and 7) may have reduced yield. It is believed that the flower buds of O'Neal, a southern highbush cultivar are not hardy at these locations, and its yield has been very low. The early blooming and maturing cultivar Duke has also continued to do poorly at both planting sites. The Laurel Fork reclamation site is about 500 ft higher in elevation than Quicksand and has much better air drainage. Moreover, based on time of apple tree bloom, plant development at Laurel Fork is about seven to 10 days behind that at Quicksand. As a result in both 2001

Table 1. Yield, average berry size, fruit quality ratings, and earliness of blueberry cultivars, Quicksand, 2002.

Cultivar[1]	Fruit Yield (lb/bush)[2]	Berry Size (oz/berry)[2]	Berry Size Rating[3]	Taste[4]	Appearance[5]	% Harvested[6] (first two harvests)	% Harvested[6] (first four harvests)
Older cultivars							
Brigitta	5.6 A	0.053	L	ST	A+	9	82
Blueray	3.8 B	0.047	L	ST	A+	49	96
Ozark Blue*	3.8 B	0.056	L	ST	A+	2	71
Toro	3.2 BC	0.060	L	SB	A+	44	100
Reka	2.5 BC	0.039	M	ST	A	65	96
Bluejay	2.4 BC	0.028	M	SB	A	39	100
Sierra	2.3 BCD	0.037	ML	ST	A+	44	98
Patriot	2.2 BCD	0.044	L	ST	A+	49	88
Bluecrop	1.8 CDE	0.095	L	SB	A+	39	94
Jersey	1.7 CDE	0.038	M	B	A	22	98
Nelson	1.5 CDE	0.043	L	ST	A+	25	94
O'Neal*	0.6 DE	0.035	M	SB	A	74	89
Duke	0.4 E	0.062	ML	S	A-	90	100
LSD[7]	1.8	NS					
Younger cultivars							
NC1832*	4.6 A	0.030 C	SM	BS	A	0	52
NC1827*	4.2 AB	0.031 C	SM	ST	A	0	73
Ornablue	3.1 BC	0.024 C	S	B	A	31	81
NC2675*	3.0 BC	0.073 A	L	SB	A+	75	100
Bluegold	2.4 CD	0.051 B	ML	T	A+	55	100
NC1852*	1.9 CDE	0.063 AB	ML	SB	A	19	100
NC2852*	1.4 DE	0.033 C	S	S	A	68	99
Spartan	0.8 E	0.066 AB	M	SB	A-	40	100
LSD[7]	1.4	0.014					

* These cultivars are 1 year younger than the other cultivars in the trial. Some cultivars were furnished by Hartman's Plant Company, P.O. Box 100, Lacota, MI 49063. Other cultivars were purchased from Fall Creek Farm & Nursery Inc., 39318 Jasper-Lowell Rd., Lowell, OR 97452.
1 In descending order of yield.
2 Means within a group followed by the same letter are not significantly different, LSD (P = 0.05).
3 Size rated visually. S = small, M = medium, L = large, VL = very large.
4 S = sweet, T = tart, B = bland.
5 A- = below average, A = average, A+ = above average.
6 Harvest dates 6/07, 6/14, 6/21, 7/01, 7/04, 7/08, and 7/15, a 38-day harvest season.
7 Least significant difference (P = 0.05).

and 2002, the blueberry yields were higher on the Laurel Fork disturbed soil site, and the plants had thicker foliage and grew better. This is in contrast to the first harvest season where Quicksand was the more productive site.

At Quicksand, Brigitta was again the highest yielding cultivar followed by Blueray and Ozark Blue. Brigitta's yield was significantly higher than those of the other 12 cultivars initially planted at Quicksand. Brigitta is an attractive, large-fruited cultivar that matures in late mid-season in Kentucky with 82% of the fruit picked during the first four harvests. Ozark Blue is another attractive, medium to late maturing berry. Even though the Ozark Blue plants were a year younger than the initially planted blueberry cultivars, it had the fourth highest yield in 2002. Two North Carolina cultivars, NC-1832 and NC-1827, gave relatively high yields at Quicksand. They had small to medium size berries with a pleasant but distinctive taste. NC-1832 tends to flower heavily and set fruit in the fall. Several other North Carolina numbered cultivars also appear to be later maturing than the named cultivars in this trial. Plants of all five North Carolina selections grew rapidly this past summer and are going to be much larger plants than the named high bush cultivars. Late maturing blueberries in Kentucky will require protective sprays to prevent damage by Japanese beetles.

At Laurel Fork, Bluecrop was the highest yielding blueberry (Table 2) followed by Nelson, Bluejay, Blueray, and Toro. The largest berry sizes were those of O'Neal, Toro, and Sierra. However, O'Neal had very few berries, which may have resulted in larger average berry size. At Quicksand, Patriot and NC-2675 had the largest berry size. Based on appearance, the most attractive blueberries at Quicksand were Brigitta, Blueray, Ozark Blue, Toro, NC-2675, and Bluegold. At Laurel Fork, Bluecrop, Nelson, Toro, Sierra, Duke, and NC-2852 were judged to be the most attractive. At the Quicksand blueberry site, Jersey, Toro, and Sierra have suffered some plant loss due to Phytophthora root rot. These results represent the third harvest of these cultivars after 4½ to 5½ years' growth. Additional harvests and observations will be needed to determine which cultivars are the best performing over time in Kentucky.

Table 2. Yield, average berry size, fruit quality ratings, and earliness of blueberry cultivars, Laurel Fork, 2002.

Cultivar[1]	Fruit Yield (lb/bush)[2]	Berry Size (oz/berry)[2]	Berry Size Rating[3]	Taste[4]	Appearance[5]	% Harvested[6] (first two harvests)	% Harvested[6] (first four harvests)
Older cultivars							
Bluecrop	4.8 A	0.047 B	M	B	A+	54	80
Nelson	4.6 AB	0.063 B	L	S	A+	59	84
Bluejay	4.6 AB	0.039 B	M	B	A	71	92
Blueray	3.7 ABC	0.058 B	M	BS	A	77	91
Toro	3.3 BC	0.074 AB	L	S	A+	86	97
Sierra	3.2 BC	0.066 AB	L	S	A+	77	95
Ornablue	3.1 C	0.030 B	S	BS	A	75	91
Patriot	3.1 C	0.044 B	S M	T	A	80	94
Brigitta	3.1 C	0.050 B	L	S	A	18	69
Bluegold	3.0 C	0.047 B	M	S	A	75	92
Reka	2.7 C	0.038 B	S M	B	A-	79	97
O'Neal*	0.3 D	0.109 A	M	B	A	95	99
Duke	0.3 D	0.055 B	M	B	A+	100	100
LSD[7]	1.5	0.044					
Younger cultivars							
NC2675*	1.0 A	0.040 B	M	ST	A	31	67
NC1827*	0.8 A	0.023 C	S M	ST	A	41	95
NC1852*	0.8 A	0.046 A	M	BS	A	96	100
NC2852*	0.5 A	0.041 AB	S	S	A+	92	100
NC1832*	0.3 A	0.025 C	S	S	A	13	75
LSD[7]	0.7	0.00468					

* These cultivars are 1 year younger than the other cultivars in the trial. Some cultivars were furnished by Hartman's Plant Company, P.O. Box 100, Lacota, MI 49063. Other cultivars were purchased from Fall Creek Farm & Nursery Inc., 39318 Jasper-Lowell Rd., Lowell, OR 97452.
1 In descending order of yield.
2 Means within a group followed by the same letter are not significantly different, LSD (P = 0.05).
3 Size rated visually. S = small, M = medium, L = large, VL = very large.
4 S = sweet, T = tart, B = bland.
5 A- = below average, A = average, A+ = above average.
6 Harvest dates 6/07, 6/14, 6/21, 7/01, 7/04, 7/08, and 7/15, a 38-day harvest season.
7 Least significant difference (P = 0.05).

Highbush Blueberry Cultivar Trial—Western Kentucky

Joseph G. Masabni, Gerald R. Brown (Professor Emeritus), and Dwight Wolfe, Department of Horticulture

Introduction

The blueberry is native to North America. At present, Kentucky has a small acreage of commercial blueberry production. Blueberries have recently been touted for their health benefits because of their high levels of antioxidants. Also, highbush blueberries have been a good supplemental crop for Kentucky growers who want to take advantage of land not suitable for tillage. For these reasons, this study was initiated in order to evaluate highbush blueberry varieties for adaptability to Kentucky soils and climatic conditions. This report updates earlier results, presented in previous issues of the Fruit and Vegetable Research Reports (1).

Materials and Methods

This trial, established in the spring of 1993 at the UK College of Agriculture Research and Education Center (UKREC), in Princeton, Kentucky, consists of eight cultivars spaced 4 ft apart within rows spaced 14 ft apart. There are 3 bushes of each cultivar per replication. Prior to planting, the pH was reduced from above 6.0 to 5.4 with elemental sulfur. The trial is mulched yearly with sawdust and is trickle-irrigated using 1-gph vortex emitters. The trial is netted in the last week of May, and fruit is harvested from the first week of June through the first week of July.

Results and Discussion

Cumulative yield from 1995 through 2002, the 2002 yield, percent ripe fruit, and berry size are presented in Table 1. Sierra, Duke, and Nelson cultivars have yielded the most fruit to date. Duke and Sunrise are the earliest ripening cultivars in this trial with 63% and 64% ripe fruit by the first week of June, respectively. Relatively little harvesting is done for all other cultivars up until the second week of June. Fruit harvest is finished for most cultivars by the end of June. One exception is Nelson, which is picked throughout the first week of July.

Another factor to be considered in selecting a cultivar is berry size (Table 1). Our data indicate that berry size can vary from the size of a pea to that of a cherry. Typically, small berries are often preferred for cooking, while larger ones are preferred for fresh consumption.

Table 1. Yield parameters of the highbush blueberry cultivar trial established in 1993 in UKREC, Princeton, Kentucky.

Cultivar[1]	Cumulative Yield 1995-2002 (lb/bush)	2002 Yield		Percent Ripe Fruit		Berry Size (g/berry)
		lb/bush	T/A[2]	June 7	June 21	
Sierra	60.9	9.6	3.7	0	91	1.9
Duke	59.9	9.7	3.8	63	100	2.0
Nelson	59.3	10.5	4.1	0	80	2.0
Toro	57.4	11.0	4.3	0	80	2.1
BlueCrop	56.5	11.5	4.5	0	82	1.7
BlueGold	50.5	8.1	3.1	17	100	1.7
Sunrise	36.3	7.3	2.8	64	100	1.6
Patriot	34.2	8.7	3.4	0	100	1.7
LSD (5%)	8.7	2.7	1.0	6	NS	0.2

1 Data are presented by cumulative yield in descending order.
2 Plant spacing is 4 ft by 14 ft, equivalent to 778 plants/acre.

Finally, when selecting a cultivar for planting, growers should also consider the difficulty of harvest. Blueberry pickers ranked the following cultivars from easiest to hardest to pick: Toro, Duke, Sierra, Sunrise, Bluecrop, Bluegold, Nelson, and Patriot.

These results should be useful to growers in selecting a blueberry cultivar. Avoiding labor peaks and harvest times conflicting with the production and/or harvest of other crops may have to be weighed against the highest yielding cultivar.

This article describes the results of the first seven harvests from this planting. Other factors important to cultivar selection are discussed in other publications (2, 3).

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Pierce's Disease, a Disease of Grapes in Kentucky and Indiana

John Hartman, Claudia Cotton, Chris Smigell, and Julie Beale, Departments of Plant Pathology and Horticulture and Hancock County Extension Office

Introduction

Pierce's disease, caused by the bacterium *Xylella fastidiosa*, is a threat to grapes in California and in southern states from Florida to Texas. Disease symptoms vary with species and cultivar, but are typified by marginal browning of leaves and death of vines. This disease is favored by the warm winter temperatures and long growing season found in the southeastern United States. Last year, Pierce's disease was found for the first time in Kentucky (1, 2).

Symptoms of Pierce's Disease

Symptoms vary with the different species and cultivars. Symptoms in spring and early summer include delayed shoot growth, leaf mottling, and dwarfing of new shoots. Late summer and fall symptoms are more dramatic and include burning, scorching, or drying of leaves; wilting or premature coloring of fruit; and uneven cane maturity. Scorching begins near the margin of the leaf blade where tissues become completely desiccated and die. As summer progresses into fall, scorching progressively spreads inward in concentric zones until the entire leaf blade is affected. Leaf blades often fall from the vine at the point of attachment to the petiole, leaving the petiole still attached to the shoot.

The disease progresses along the grape vine with symptoms developing in adjacent leaves along the shoot both above and below the point of initial infection. Flower clusters on infected vines usually dry up. Late in the season, wood on affected canes fails to mature normally, leaving green "islands" of tissue that persist into the dormant season and can be seen on canes throughout the winter. Tips of shoots often die the first year the vine is infected. Initially, only one or a few canes on a vine show foliar and wood symptoms. Symptoms are more pronounced in vines that are stressed by high temperatures and drought conditions.

Grape Susceptibility and Disease Spread

Some grape cultivars are very susceptible, usually dying within two years. Most French (*vinifera*) varieties die within two to five years, while American (*labrusca*) varieties often live longer than five years. French-American hybrids are intermediate in susceptibility. Pierce's disease is spread by several types of sharpshooter leafhoppers, spittlebugs, and grafting.

For many years, trees, especially oaks, in Kentucky landscapes have suffered from bacterial leaf scorch disease, also caused by *X. fastidiosa* but a different strain from the one that causes Pierce's disease. Leaf scorching symptoms associated with this disease annually appear in late summer. Symptoms are quite striking on pin and red oaks, with individual leaves turning one-third to two-thirds brown on the leaf ends and margins. The causal agent of bacterial leaf scorch is also vectored by leafhoppers or other xylem-feeding insects. As far as is known, the grape pathogen is the same species as the tree leaf scorch pathogen, but is a different strain. Thus, the disease would not be spread from trees to grapes.

The objective of this study was to begin a survey of vineyards in Kentucky (and of one vineyard which we were called to in southern Indiana) to determine where Pierce's disease was occurring.

Materials and Methods

Grape leaves showing leaf burning symptoms or dead areas on the leaf were collected from vineyards statewide and in one southern Indiana county and delivered to the UK Plant Disease Diagnostic Laboratory. Petioles from affected leaves were crushed with a mortar and pestle so that the extract could be tested for presence of the pathogen using a special laboratory test, an enzyme-linked immunosorbent assay (ELISA) developed for *X. fastidiosa* ("Pathoscreen-Xf," Agdia Inc., Elkhart, Ind.). Color reactions for the ELISA test were evaluated visually.

Results and Discussion

In all, 42 grape specimens from 13 vineyards were assayed in the laboratory. They included the cultivars Chancellor, DeChaunac, Foch, Mars, Merlot, Riesling, Vidal, and other cultivars, and also wild grapes where they were found near the vineyard.

From these tests *X. fastidiosa* was detected in Mars grapes from Hancock County and in Chancellor grapes from southern Indiana. Thus, although Pierce's disease is not yet widespread in Kentucky, it is now confirmed still to be present in Kentucky and is found for the first time in Indiana.

In the laboratory, we are developing a PCR test that we hope will tell whether the grape strains of *X. fastidiosa* found here are the same or different from *X. fastidiosa* in landscape trees in the region. This disease can be devastating to grape production, and much more Kentucky research is needed. Studies are also under way to determine which leafhopper vectors might be spreading Pierce's disease in Kentucky. Where the disease is isolated, removal of infected vines should keep further spread to a minimum.

With an emerging grape industry developing in Kentucky, it is important that growers and County Extension Agents be on the lookout for this disease. Personnel in the UK Plant Disease Diagnostic Laboratory can run the specialized tests needed to determine the presence of the Pierce's disease bacterium.

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Rootstock and Interstem Effects on Pome Fruit Trees

Joseph G. Masabni, Gerald R. Brown (Professor Emeritus), and Dwight Wolfe, Department of Horticulture

Introduction

Although apple is the principal tree fruit grown in Kentucky, the state's hot, humid summers and heavy clay soils make apple production a more difficult task for Kentucky growers than for growers in the major apple-producing regions having more favorable conditions. The hot and humid summers are also a factor in the high disease and insect pressure on orchards in Kentucky.

In spite of these challenges, productive orchards are one of the highest per-acre income enterprises suitable for rolling hills and upland soil. Furthermore, in these sites orchards have a low potential for soil erosion. Still, Kentucky imports more apples than it produces.

Continued identification of improved rootstocks and cultivars is required for growth of the Kentucky fruit industry. For this reason, Kentucky cooperates with 39 other states and three Canadian provinces in the Cooperative Regional NC-140 Project titled "Rootstocks and Interstem Effects on Pome Fruit."

The NC-140 trials are of utmost importance to Kentucky growers in terms of gaining access to and testing new rootstocks from around the world. The detailed and objective evaluation of these rootstocks provides growers with valuable information needed to select the most appropriate rootstocks when they become commercially available.

The 1994 and 1999 apple rootstock trials are designed to compare the adaptability of the slender-spindle and the French vertical-axe systems in orchards grown on our fertile soils. In addition, the semi-dwarf rootstocks in the 1999 apple rootstock trial will provide information on the ability of these rootstocks to support themselves without a trellis. The 2002 apple trial will provide us with information on the differences in performance among clones of rootstocks.

The NC-140 orchard trials are used regularly as demonstration plots for visiting fruit growers, Extension personnel, and research scientists. The research data collected from these trials will help establish base-line production and economic records for the various orchard system/rootstock combinations that can be utilized later by Kentucky fruit growers.

Materials and Methods

Scions of known cultivars on various rootstocks were produced by commercial nurseries and distributed to cooperators for each planting. The University of Kentucky has three NC-140 rootstock plantings at the UK Research and Education Center at Princeton (UKREC):

I. The 1994 apple rootstock trial consists of Red Gala on six rootstocks and 10 replications per rootstock. Trees are spaced 13 ft apart within rows 18 ft apart. Trickle irrigation was installed, and a trellis system was constructed in 1995.

II. The 1999 dwarf and semi-dwarf apple rootstock trial consists of two groups:
i) 11 dwarfing rootstocks with six replications per rootstock. Trees are planted on a 10-ft by 16-ft spacing.
ii) six semi-dwarfing rootstocks with six replications per rootstock. Trees are planted on a 13-ft by 20-ft spacing.

III. The 2002 apple rootstock trial consists of Buckeye Gala on nine rootstocks with seven replications per rootstock. Trees are spaced 8 ft apart within rows 15 ft apart.

The experimental field is laid out as a randomized block design. Orchard floor management consisted of a 6.5-ft herbicide strip with mowed sod alleyways.

Trees were fertilized and sprayed according to local recommendations (1, 2). Yield, trunk circumference, and maturity indices were measured.

Results and Discussion

The winter of 2002 was mild, followed by a wet spring and below-normal rainfall from June through August. Summer temperatures were above normal. Rainfall was moderate to above normal throughout the remainder of the growing season. An early spring hailstorm severely damaged the fruit in the 1999 NC-140 trial. Several trees were also blown over.

I. 1994 Apple Semi-Dwarf Rootstock Trial

This is the first orchard trained to the French vertical-axe system at this station. It includes a number of new rootstocks, along with others that have performed well in previous trials at this location.

Survival of trees on M.26 EMLA rootstock (10% survival) differed significantly from trees on the other three rootstocks (90% survival). Cumulative yield, yield in the year 2002, trunk cross-sectional area, fruit size, flesh firmness, and number of root suckers varied significantly among rootstocks (Table 1). No significant differences were observed for percent soluble solids (data not shown). Trees on CG.30 and V.2 rootstocks have been the most productive in this trial. On the other hand, trees on B.9 rootstocks have been the least productive.

II. 1999 Dwarf and Semi-Dwarf Apple Rootstock Trial

This trial consists of two groups of apple rootstocks, a dwarfing group with 11 rootstocks, and a semi-dwarfing one with six rootstocks. Eight of the dwarfing and three of the semi-dwarfing rootstocks had not been tested previously at UKREC. At planting time, we received 90 trees of a possible 102 for this trial because 12 trees were not available for our site (one each of G.16N, CG.6814, and CG.5202, two CG.4013, three CG.3041, and four CG.30N). Furthermore, three trees never leafed out after planting (one G.16T, one G.16N, and one CG.3041). Five trees in the dwarf

Table 1. Results of the year 2002 for the NC-140 1994 apple semi-dwarf rootstock trial, UKREC, Princeton, Kentucky.

Rootstock*	Cumulative Yield (lb/tree)	2002 Yield (lb/tree)	Trunk Cross-Sectional Area (in.^{2})	Fruit Size (oz/fruit)	Flesh Firmness (lb)	Number of Root Suckers
CG.30	758	159	11.5	5.0	15.2	7
V.2	633	128	6.5	5.3	17.0	2
M.26 EMLA	465	79	7.3	4.2	13.4	0
B.9	302	62	4.0	4.6	14.3	1
Average	*549*	*145*	*8.8*	*4.9*	*15.4*	*3*
LSD (5%)	216	97	2.6	0.8	2.0	6

* Arranged in descending order by cumulative yield.

planting (one each of CG.5179, G.16N, G.16T, and two of CG.5202) and seven trees in the semi-dwarf planting (one each of CG.6814 and M.26, two CG.7707, and three Supporter 4) broke off at either the roots or the graft union this summer. No statistical differences in mortality were observed among the rootstocks for either group.

For both groups, significant differences were observed for trunk cross-sectional areas, yield in 2002, and cumulative yield (Table 2). The number of root suckers, flesh firmness, and the percent soluble solids varied significantly only among the dwarf rootstocks. Average fruit weight did not vary significantly by rootstock for either the dwarf or semi-dwarf group. Twenty-two of the 31 semi-dwarf trees planted are now supported by tree stakes due to their lean exceeding 30° from vertical. Some of these trees have blown over, breaking at the roots or at the graft union.

III. 2002 Apple Rootstock Trial

This trial compares nine rootstocks consisting of three clones of M.9, two clones each of B.9 and M.26, and one clone each of Supporter 4 and of P.14. Sixty-three trees of Buckeye Gala, nine different rootstocks and seven replications per rootstock, were planted in a randomized complete block design in a block of seven rows with a pollenizer tree at the ends of each row. A trellis was constructed and trickle irrigation installed a month after planting. To date, all trees are alive and growing vigorously.

Significant differences were observed for both spring and fall trunk cross-sectional areas and for the change in trunk cross-sectional area from spring to fall. No differences were observed in number of feathers or number of suckers (Table 3).

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Table 2. Results of the year 2002 for the NC-140 1999 apple dwarf and semi-dwarf rootstock trial, UKREC, Princeton, Kentucky.

Rootstock	Cumulative Yield (lb/tree)	2002 Yield (lb/tree)	Trunk Cross-Sectional Area (in.^{2})	Number of Root Suckers	Flesh Firmness (lb)	Percent Soluble Solids	Fruit Weight (oz)
*Dwarfing**							
CG.4013	89.9	64.4	5.3	14.0	20.3	13.7	5.0
G.16T	80.9	57.1	4.2	1.8	20.5	14.1	4.8
CG.5202	67.5	62.6	4.1	8.3	20.3	13.3	5.0
G.16N	64.2	37.5	29.0	2.3	22.5	14.1	5.1
M.9 NAKBT 337	57.8	48.9	16.8	2.8	20.1	13.3	5.5
Supporter 2	54.2	33.7	20.1	0.3	20.9	13.7	5.0
M.26 EMLA	51.1	46.5	18.7	1.7	19.8	13.6	5.4
Supporter 3	50.9	23.8	18.9	2.0	23.1	15.2	4.8
CG.5179	48.3	41.0	20.5	2.4	20.3	14.1	4.8
Supporter 1	47.2	23.4	19.7	3.7	22.9	14.6	4.8
CG.3041	31.7	13.4	26.7	0.5	22.5	11.7	5.6
Average	*58.4*	*41.0*	*22.4*	*3.3*	*20.9*	*13.9*	*5.0*
LSD (5%)	20.5	26.5	5.9	5.9	2.4	1.5	NS
*Semi-Dwarfing**							
CG.30N	66.1	48.9	5.2	5.5	20.9	12.8	6.2
CG.4814	60.0	58.4	4.0	9.3	20.3	14.6	5.5
M.26 EMLA	34.8	24.7	3.2	0.4	21.4	14.5	5.9
CG.7707	31.7	29.5	5.7	4.8	21.2	14.1	5.8
M.7 EMLA	28.0	20.1	5.1	25.2	21.4	15.0	5.4
Supporter 4	23.4	12.1	2.7	9.3	23.6	16.1	4.9
Average	*37.9*	*30.4*	*4.3*	*10.3*	*21.4*	*14.6*	*5.6*
LSD (5%)	26.9	24.3	1.9	NS	NS	NS	NS

* Within groups, arranged in descending order by cumulative yield.

Table 3. Results of the year 2002 for the 2002 NC-140 apple rootstock trial, UKREC, Princeton, Kentucky.

Rootstock*	Spring Trunk Cross-Sectional Area (in.^{2})	Fall Trunk Cross-Sectional Area (in.^{2})	Growth** (in.^{2})	Number of Feathers	Number of Suckers
M.26 NAKB	0.26	0.67	0.41	2.3	0.0
M.26 EMLA	0.22	0.62	0.40	1.4	0.1
P.14	0.26	0.62	0.36	1.9	0.0
Supporter 4	0.26	0.54	0.28	1.0	0.4
B.9 Treco	0.20	0.47	0.27	0.0	0.0
M.9 Nic29	0.26	0.50	0.24	2.4	0.6
M.9 T337	0.18	0.42	0.24	0.6	0.0
M.9 Burg 756	0.20	0.41	0.21	1.4	0.0
B.9 Europe	0.20	0.39	0.19	0.4	0.0
Average	*0.23*	*0.52*	*0.30*	*1.3*	*0.1*
LSD (5%)	0.04	0.11	0.10	NS	NS

* Arranged in descending order by growth of trunk cross-sectional area.
** Growth in trunk cross-sectional area from spring to fall, 2002.

Optimal Training of Apple Trees for High Density Plantings

Joseph G. Masabni, Gerald R. Brown (Professor Emeritus), and Dwight Wolfe, Department of Horticulture

Introduction

Kentucky apple growers often have a problem with excessive vegetative growth or vigor of their trees, which greatly reduces the production that can be achieved from high density apple plantings. Early production and optimal fruit size on vigorous sites are obtained when photosynthates are balanced properly between flower bud initiation and vegetative growth. Pruning and training are possibly the most important operations performed by growers to maintain the proper balance between flower bud initiation and vegetative growth. Identification of effective pruning and training techniques for vigorous sites is required for continued expansion of apple production in Kentucky. The University of Kentucky College of Agriculture (UK) and the Kentucky State Horticultural Society (KSHS) have made long-term commitments to help meet this need and are cooperating in this ongoing research, the purpose of which is to determine the best training and pruning practices needed to obtain early production and optimal fruit size from trees trained to the slender-spindle or the French vertical-axe system.

Materials and Methods

One hundred-sixty trees of Golden Delicious on M.9 rootstocks were planted in May 1997 in a randomized complete block design consisting of five rows and 32 trees per row. At planting, trunk circumference at 12 inches above the soil surface averaged 2.4 inches and did not vary significantly among rootstocks. A trellis was constructed, and trickle irrigation was installed. Trees were spaced 8 ft apart within rows 16.4 ft apart. Orchard floor management was a 6.5-ft herbicide strip with mowed sod alleyways. Trees were fertilized and sprayed according to local recommendations (1, 2). Beginning in 1998, yield, trunk circumference, and maturity indices such as soluble solids and flesh firmness were measured after harvest.

The trees were trained according to detailed treatment protocols presented in Table 1. Trees began to fill their allotted space in 1999, and leader management was modified to maintain leaders at specified heights (Table 1). Limbs of one tree that overlapped or touched those of adjacent trees were headed back to two-year-old wood.

Results and Discussion

No significant differences were observed between the French vertical-axe and the slender-spindle training systems for any of the measured variables. Therefore, all data are presented as the combined values for both systems. No differences among the four pruning levels were observed for cumulative yield (1998-2002), yield in 2002, fruit weight, and trunk circumference (Table 2).

Pruning time per tree was not analyzed statistically; thus, no LSD values are presented in Table 3. Even though pruning time per tree appears to be the highest for the heavy pruning level, this difference was not significant to the pruning crew. Pruning time, when adjusted for pounds of fruit produced, did not differ among the four treatments (Table 3). Total pruning and training periods were 14 weeks in 1997, 12 weeks in 1998, 18 weeks in 1999, four weeks in 2000, four weeks in 2001, and one week in 2002.

This planting has been regularly used as a demonstration for visiting apple growers, Extension personnel, and research scientists. The data collected in these trials have helped establish baseline economics and production methods for the various orchard system/rootstock combinations that can be utilized by Kentucky fruit growers.

Table 1. Details of pruning and training treatments of the 1997 apple training study at UKREC, Princeton, Kentucky.

System	Amount of 1-Year-Old Wood Left After Heading at Planting	Pruning		Training			
		Level	Interval in Weeks	Limb Angle[1]	Limb Management[2]	Leader Management 1999[3]	Leader Management 2000[4]
French Axe	Not headed	Light	1	45	No	D	12
French Axe	12-16 in.	Moderate	2	45-60	Yes	C&D	11
French Axe	12-16 in.	Moderate	1	45-60	Yes	D	11
French Axe	8-12 in.	Heavy	1	60-90	Yes	D	10
Slender Spindle	Not headed	Light	1	45	No	A	9
Slender Spindle	14-20 in.	Moderate	2	45-60	Yes	B	9 Y
Slender Spindle	14-20 in.	Moderate	1	45-60	Yes	B	9 Y
Slender Spindle	10-14 in.	Heavy	1	60-80	Yes	C	9 Z

1 Angle at which limbs are positioned.
2 French Axe: remove overly vigorous branches with narrow angles when 3 to 6 inches long. Slender Spindle: remove branches that compete with leader. In 2000, for both training systems, limbs overlapping or touching those of adjacent trees were headed back into 2-year-old wood.
3 A = weak leader renewal and new leader headed at 12 inches. B = bend leader at 60 angle, alternating direction with every 18" of new growth. C = leader bagged 1 month prior to bud break and bag removed at appropriate time. D = leader bent to horizontal, alternating direction after buds break on top side.
4 Leaders were maintained at specified heights (ft) by cutting to an alternate leader when necessary. Y = Alternate leader was bent to horizontal for 6 weeks. Z = Alternate leader was "snaked" throughout growing season. Leader management was the same in 2002 as in 2000 and 2001.

Table 2. Effects of pruning and training treatments on yields of the 1997 apple training study at UKREC, Princeton, Kentucky.

Pruning[1] Level	Interval in Weeks	Yield (lb/tree)					2002		
		1998	1999	2000[2]	2001	2002	Cumulative Yield[3] (lb/tree)	Fruit Weight (oz)	Trunk Circumference (in.)
Light	1	1.3	19.8	11.2	92.7	39.2	167.0	5.46	9.33
Moderate	2	2.0	22.0	23.4	83.1	51.1	179.8	5.36	9.10
Moderate	1	2.4	17.1	23.7	85.8	54.8	180.4	5.04	8.95
Heavy	1	0.2	20.5	21.4	80.4	53.1	177.3	5.41	9.24
Average		*1.5*	*19.8*	*19.9*	*85.7*	*49.4*	*176.0*	*5.33*	*9.16*
LSD (5%)		0.9	NS	6.60	20.7	NS	NS	NS	NS

1 Pruning level represents combined values for Slender Spindle and French Vertical Axe.
2 Starting in 2000, the pruning protocol was changed to once early in the season for all treatments.
3 Yield is the sum of picked and dropped fruit. Dropped fruit averaged 9.1 lb/tree in 2002.

Table 3. Time required for pruning and training of the 1997 apple training study at UKREC, Princeton, Kentucky.

Pruning[1] Level	Interval in Weeks	Minutes per Tree						Total Minutes per Tree	Minutes per Pound of Fruit
		1997	1998	1999	2000[2]	2001	2002		
Light	1	12.2	10.2	18.2	4.4	9.6	6.1	60.7	0.36
Moderate	2	9.6	8.6	16.5	3.4	9.6	6.6	54.3	0.30
Moderate	1	11.4	11.1	19.1	2.1	9.6	5.6	58.9	0.33
Heavy	1	11.9	12.0	21.6	2.5	9.5	7.0	64.5	0.36
Average		*11.3*	*10.3*	*18.9*	*3.0*	*9.6*	*6.3*	*59.4*	*0.34*

1 Pruning level represents combined values for Slender Spindle and French Vertical Axe.
2 Starting in 2000, the pruning protocol was changed to once early in the season for all treatments.

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Yields and Gross Returns from New Slicing Cucumber Varieties

Brent Rowell, April Satanek, Darrell Slone, and John C. Snyder, Department of Horticulture

Introduction

Slicing cucumbers have become a profitable "new" crop for a number of Kentucky growers. Growers planted more than 50 acres of slicing cucumbers this year for fresh market sales through new marketing cooperatives in Central and Western Kentucky. Slicing cucumber trials had not been conducted in Kentucky since 1989, and many new disease-resistant hybrids have come on the market since then. Some Kentucky growers have tried trellising cucumbers to achieve higher yields of more uniformly dark green fruit. Anecdotal evidence suggests that trellising improves color and lowers the incidence of "yellow bellies"; however, this has not been tested, and it is not known if an increase in yields of higher quality cucumbers would pay for the labor and material costs of trellising. Although the primary purpose of this trial was to compare new varieties, we also wished to observe differences between trellised and non-trellised cucumbers.

Methods and Materials

Sixteen slicing cucumber varieties were compared for yield, potential returns, and overall appearance in the spring of 2002 at the Horticultural Research Farm at Lexington. Dasher II and Marketmore 76 were included as standard (check) varieties. Marketmore 76 is an old standard for disease resistance, while Dasher II is one of the most popular hybrids in the region. With the exception of open-pollinated Marketmore 76, all varieties tested were gynoecious F1 hybrids with approximately 12% pollinators. All varieties are reported to have disease resistance although our trial was nearly disease-free and resistance was not evaluated in this trial.

Cucumbers were seeded in 72-cell flats in the greenhouse on 16 May and transplanted to the field after 12 days on 29 May. Most cultural practices were according to our current commercial recommendations for Kentucky. A total of 50 lb N/A was applied prior to transplanting; an additional 70 lb N/A from ammonium nitrate was fertigated in seven weekly doses of 10 lb N/A. All P and K were applied preplant according to recommendations based on soil tests. The fungicide Ridomil Gold was applied on 28 May and was followed by alternating weekly applications of Bravo or Quadris for disease control. The systemic insecticide Admire was applied as a post-transplant drench one day after transplanting for cucumber beetle/bacterial wilt control. A single application of Pounce and two applications of Sevin were made after 27 June for cucumber beetle control.

Plots consisted of raised beds 8 ft long with black plastic mulch and drip irrigation; bed centers were 6 ft apart. Single plants were spaced 12 inches apart within double rows (two rows/bed) with approximately 15 inches between double rows (16 plants/plot). Plots were replicated four times in a randomized complete block design. Cucumbers were harvested every three to four days from 1 July to 29 July for a total of nine harvests. After grading into either marketable fruit or culls, fruits were counted and weighed. Marketable fruits were sorted according to USDA grades U.S. Fancy, U.S. No. 1, U.S. No. 1 Large, U.S. No. 1 Small, and U.S. No. 2.

Yields, Gross, and Early Returns. Average yields of each USDA grade were compared using Waller-Duncan's LSD (k-ratio t-tests, P = 0.05) following an analysis of variance. Although yields for these grades are important, we believe that the large tables of data usually reported are confusing and often difficult to interpret. Although reporting only total marketable yields simplifies matters, this variable is of limited practical use to commercial growers and can mask more important economic considerations. It is possible that some varieties with high total marketable yields might have been later maturing with a larger proportion of their marketable yield achieving only marginal prices later in the season. Making planting decisions based on total marketable yield data alone could lead to disastrous results.

Because we believe comparing the potential income or gross returns per acre is a more useful way of evaluating yield data from several different grades, raw data were converted by multiplying the yield of each grade by that grade's actual price for that harvest date. Yields in pounds per acre were first converted to boxes per acre by dividing yield by the average weight of one 1 1/9 bushel box of slicing cucumbers (55 lb). Box yields were multiplied by actual average weekly wholesale prices received by a Kentucky cooperative less box costs, packing charges, and commissions (Table 1). The resulting single variable "gross return" provides a better indicator of a variety's overall performance, taking into account yields of the different grades and their price differentials. "Early returns" were calculated in the same way using data from only the first three harvests on 1 July, 5 July, and 8 July.

Trellising. In order to make preliminary observations on the possible benefits from trellising, the four blocks (replications) in this trial were treated as follows (all plots on raised beds with black plastic and drip irrigation):

- Block 1: no trellis.
- Block 2: simple trellis; tomato stakes were placed on each side of the beds every 4 ft of row (every four plants). Tomato twine was wrapped around each stake to create a "fence" on both sides of the bed. Cucumber plants were simply laid up upon this "fence" by hand and were not

Table 1. Average weekly wholesale prices received for slicing cucumbers during the trial harvest period from 1-29 July 2002. Prices are FOB less $1.40 box/packing charge and less 16% marketing commissions. Prices are dollars per standard 1 1/9 bu (55 lb) carton.

	Market Grade[z]			
	Super-select	Select	Small	24-Count
Week Ending	price per box ($)			
06 Jul	9.99	5.21	9.89	3.23
13 Jul	11.41	6.58	7.61	2.96
20 Jul	5.70	4.06	5.75	1.57
27 Jul	5.95	2.66	4.32	0
03 Aug	4.69	0.80	3.91	0.05

[z] Market grades correspond to the following USDA grades: Superselect = U.S. Fancy + U.S. No. 1;
Select = U.S. No. 2; Small = U.S. No. 1 Small; 24-count = U.S. No. 1 Large.

otherwise trained to the trellis (Figure 1). Four stringings were used to make trellises in all trellised blocks.

- Blocks 3 & 4: more complex trellis; stakes placed as in Block 2 but with strings that crossed over from one side of the bed to a stake on the opposite side, creating an "X" pattern. It was thought that this method might be better for training vines to the trellis (Figure 2).

Although this arrangement of trellising or not trellising blocks does not allow for statistical comparisons, it was intended to give us some indication of the possible benefits from trellising. In addition to this trial, several farmers' field demonstrations of trellising for slicing cucumbers were conducted in 2002, the results of which can be found elsewhere in this volume.

Fruit Appearance Ratings. All fruits of each trial entry harvested from all four replications were graded and laid out on the ground for careful examination and appearance ratings on 12 July. Fruits were visually assessed for shape, extent of yellow color, and overall appearance. Appearance ratings took into account, in order of importance, overall attractiveness, shape, shape uniformity, and color.

Results and Discussion

Yields and Returns. Varieties are ranked from highest to lowest yield of a combination grade of U.S. Fancy plus U.S. No. 1 fruits in Table 2. This combination corresponds to the trade designation Superselect. The U.S. No. 2 grade corresponds to the Select category, while fruits of the U.S. No. 1 Large grade are usually packed as 24 count (24 fruits/box). The group of highest yielding varieties included SRQ 2389, Dasher II, Daytona, Panther, Indy, and Thunder; these were not statistically different from SRQ 2983, which was the highest yielding entry (Table 2). All varieties in this group had 65% or more fruit graded as Superselect except for SRQ 2389 (59%). Other varieties with high average percentages of Superselect fruit included Stonewall, General Lee, Greensleeves, Intimidator, and Turbo.

Sunseed's SRQ 2983 and SRQ 2389 had significantly higher gross returns than the other varieties tested (Table 2). Other varieties with very high returns included Daytona,

Figure 1. Simple trellising method used in Block 2 of slicing cucumber cultivar trial at Lexington, 2002.

Figure 2. Trellising method using crossed twine used in Blocks 3 and 4 of slicing cucumber cultivar trial at Lexington, 2002.

SRQ 2387, and Dasher II. Early returns were highest for Thunder, Speedway, SRQ 2983, and Daytona. While there were no statistically significant differences among the qualitative assessments shown in Table 3, average overall appearance scores tended to be higher for Panther, Indy, Stonewall, Speedway, and Turbo. Appearance scores tended to be lower for Intimidator, Daytona, SRQ 2387, and Thunder. SRQ 2389, SRQ 2387, SRQ 2983, Stonewall, Dasher II, Turbo, and Thunder, tended to have less fruit yellowing,

Table 2. Marketable yields and gross returns of slicing cucumber varieties and advanced breeding lines; data are averages from four replications at Lexington, Kentucky, 2002. Entries ranked from highest to lowest yield of U.S. Fancy plus U.S. No. 1 grade fruits.

		Marketable Yields[z]						
Entry	Seed Source	U.S. Fancy+ U.S. No. 1 (tons/acre)	% Fancy+ No. 1 (%)	U.S. No. 2 tons/acre	U.S. No. 1 Large tons/acre	Gross Returns[y] $/acre	Early Returns $/acre	Overall Appearance[x]
SRQ 2983	SS	35.1	71	8.4	6.0	11555	4495	4.5
SRQ 2389	SS	33.8	59	13.7	9.6	12311	4153	4.5
Dasher II	S	31.1	75	5.4	5.1	9951	4086	5.0
Daytona	S	30.4	70	7.8	5.3	10392	4314	4.0
Panther	SS	30.4	65	6.1	10.1	9879	3737	5.7
Indy	S	30.1	71	5.9	6.7	9589	3855	5.7
Thunder	S	29.9	74	6.2	4.5	9922	4802	4.2
SRQ 2387	SS	28.6	62	10.2	7.6	10314	4053	4.0
Greensleeves	HM	28.6	70	7.7	4.5	9627	4012	5.0
Stonewall	HM	27.4	75	5.9	3.1	8699	3594	5.7
General Lee	HM	27.2	72	6.7	4.1	9079	3274	4.0
Speedway	S	26.8	63	7.7	8.6	9586	4641	5.5
Intimidator	S	26.1	67	8.3	4.4	9237	4126	3.7
Turbo	S	24.5	66	7.9	4.7	8162	2087	5.5
SliceMore	SK/SW	23.0	60	8.3	7.4	8447	3426	4.5
Marketmore 76	SW	20.0	64	5.4	5.8	6657	1470	5.0
Waller-Duncan LSD (P = 0.05)		*5.8*	*6.3*	*2.5*	*3.7*	*1593*	*772*	*ns*

z The combined yields of USDA grades Fancy and U.S. No. 1 are equivalent to the Superselect marketing category, while U.S. No. 2 grade is equivalent to Select; yields of U.S. No. 1 Large are equivalent to yields of cucumbers used in 24-count packs.

y Gross returns are calculated for each entry by multiplying yields of each marketing category (Superselect, Select, and 24-count) by its appropriate price for a given harvest date (9 harvests). Prices used were actual average weekly prices received by a Kentucky cooperative from July 1-30, 2002 less $1.40/box packing/box charge and less 16% commissions. Higher returns may reflect earlier yields and/or higher yields of Superselect cucumbers. Prices are shown in Table 1.

x Appearance ratings: 1 = worst; 9 = best taking into account, in order of importance, shape, shape uniformity, and color.

while Marketmore 76 and Speedway appeared to have more fruit yellowing than the other varieties (Table 3). Intimidator tended to have more misshapen or curved fruits than the other varieties tested.

Trellising. Since each trellising method was applied uniformly to all varieties in a separate block or replication in the trial, it was impossible to make any conclusive statements regarding benefits of trellising based on these results. As we were well aware when planning the trial, the effects of trellising were confused ("confounded" is the proper statistical term) with the effects of field position (the location of a block and its trellising method in the trial field). Having said that, however, it is still useful to call attention to our observations, especially for characteristics like fruit color and appearance that are likely less affected by field position than by trellising. There was a highly significant difference among blocks/trellising methods for the extent of yellowing on fruits with the untrellised block showing the most yellowing (rating of 2.3 on a scale of 1 to 5 where 1 = best [no yellow color on most fruits] and 5 = worst [large percentage of fruit surface is yellow on most fruits]). Fruits from the simple trellis block showed the least yellowing (1.2 rating). While there were no other statistical differences among blocks/trellising methods for fruit quality ratings, the trend was for slightly better fruit appearance ratings with trellising than without trellising (data not shown). We also found no indication of improvement of fruit color or appearance with the more complex trellis versus the simpler trellis. We also noticed that cucumber beetle damage to fruits tended to be more serious in the trellised blocks where it was more difficult to achieve complete spray coverage. The question for further research is whether a small improvement in fruit appearance is worth the considerable added expense of trellising.

Table 3. Fruit shape, color, and overall appearance assessments for slicing cucumber varieties; scores are averages for all fruits of each variety from four replications harvested on 12 July 2002; varieties are listed from highest to lowest U.S. Fancy + U.S. No. 1 yields.

Entry	Shape[z]	Fruit Yellowing[y]	Appearance Rating[x]
SRQ 2983	2.5	1.7	4.5
SRQ 2389	2.0	1.2	4.5
Dasher II	3.5	1.5	5.0
Daytona	2.7	2.0	4.0
Panther	3.0	2.2	5.7
Indy	3.5	2.2	5.7
Thunder	2.7	1.5	4.2
SRQ 2387	2.2	1.2	4.0
Greensleeves	3.0	1.7	5.0
Stonewall	3.0	1.2	5.7
General Lee	2.7	2.0	4.0
Speedway	3.2	2.7	5.5
Intimidator	2.7	2.0	3.7
Turbo	3.0	1.5	5.5
Slice More	2.7	2.0	4.5
Marketmore 76	3.5	3.0	5.0
Statistical significance (P = 0.05)	ns	ns	ns

z Shape ratings: 1 = worst (large percentage of misshapen fruits) to 5 = best (most fruits uniform, long, straight, cylindrical).

y Extent of yellowing: 1 = best (no yellow color on most fruits) to 5 = worst (large percentage of fruit surface yellow on most fruits).

x Appearance ratings: 1 = worst; 9 = best taking into account, in order of importance, shape, shape uniformity, and color.

We recommend the following varieties for further on-station trials and for small test plantings in growers' fields: SRQ 2983, SRQ 2389, Panther, Greensleeves, and Stonewall. Dasher II, Daytona, Indy, and Speedway will remain in the list of suggested slicing cucumber varieties for Kentucky growers.

Acknowledgments

The authors would like to thank the following persons for their hard work and assistance in the successful completion of this trial: Dave Lowry, Larry Blanford, Phillip Bush, Barry Duncil, Justin Clark, Stephanie Goode, Courtney Bobrowski, Witoon Jaiphong, Sopon Issaravut, Takanobu Suzuki, Darren Taylor, Eric Bowman, and Spencer Helsabeck.

Trellising Slicing Cucumbers in Western Kentucky

Clint Hardy and Brent Rowell, Department of Horticulture

Introduction

Fresh market slicing cucumbers are being grown in Western Kentucky as a supplement to tobacco and other farm enterprises. Growers are interested in producing long, straight, dark green cucumbers that show very little yellowing. A combination of U.S. Fancy and U.S. No. 1 grades (i.e., "Superselect") receives the highest prices, and growers naturally want as much of their harvest to be in this category as possible. In this demonstration trial, we evaluated two different trellising methods to determine which, if any, produced more quality fruit, and if increased yields from either method would pay for the cost of trellising.

Materials and Methods

The variety chosen for the demonstration was Speedway, which performed well in 2001. The trial plots were located within a grower's field in McLean County. Besides trellising, the grower-cooperators kept the plots sprayed, maintained, and watered. Plants were started in 242-cell trays and transplanted to the field on 31 May using raised beds, black plastic mulch, and drip irrigation. The trial was set up as a randomized complete block design with four replications. Each plot contained 50 plants in 18-inch- wide double rows with 15 inches between plants within the rows. Phosphorus and potassium fertilizer was applied based on soil test results. One-half of the total of 100 lb N/A was applied prior to planting with the remainder applied weekly through drip irrigation at 10 lb N/A per application. No herbicides were used, and no insecticides were used until after the crop was established. Bravo fungicide was applied weekly according to current UK recommendations. Treatments were: 1) no trellis, 2) single-stranded trellis wrapped in five "layers" or stringings, and 3) a double-stranded trellis also in five stringings. Plots were scouted twice weekly to monitor pests and diseases. Plots were harvested 13 times between 24 June and 29 July.

Trellis Types. Stakes for the trellises were ordinary 52-inch long tobacco sticks that were driven 9 inches into the raised beds directly in the plant row. A stick was placed every five plants (about 6 ft apart). Since there were two rows per bed, there were also two rows of sticks on each bed. Two sticks were also driven every 25 plants on each row to serve as braces for the structure and to allow a gap to pass harvest buckets across. With the sticks in place, we began the stringing process. Staked tomato twine was used. The twine was wrapped around a stick once and then moved to the next stake. This was done at five different positions, beginning at 6 inches above the plastic and ending at the top of the stick. When finished, the trellis looked similar to a five-strand fence (Figure 1). The double-strand trellis type was exactly the same as the single, but two strings were used to see if the plant would be better supported when it held a full fruit load. The vines were manually trained twice prior to the first harvest in order to ensure the trellises were used to their full potential.

New tobacco sticks cost $0.15 each; this cost can be amortized over two years resulting in an annual cost of $0.07/stick. Approximately 2,070 sticks are required per acre so stake costs would be around $145 per acre. The estimated labor cost for trellis establishment and removal was $400 per acre. Total material and labor costs for trellising cucumbers were about $600/acre.

Figure 1. Trellised cucumber planting (single strands) in Daviess County, Kentucky, 2002

Results and Discussion

Cucumbers from the same treatment but from different replications were inadvertently combined at harvest so that it was impossible to perform statistical analyses on the data collected; however, some general trends were observed. Yields of Superselect cucumbers were considerably higher for the trellised treatments (nine to 10 boxes/plot) than for non-trellised (six boxes/plot), while yields for most other grades were similar among the treatments (Table 1). More fruit was culled from the non-trellised plots than from trellised plots (Table 1). There appeared to be little difference between the single- and double-stranded trellises.

No time was saved in harvesting trellised versus non-trellised cucumbers. It was also observed that due to better exposure to sunlight, trellised cucumbers were more uniform in color than the non-trellised. Early summer was a good growing season this year, and cucumbers were little affected by disease. We observed that the trellised cucumbers could have been picked for about two weeks longer than those grown on the ground. When the non-trellised vines began to grow off the plastic and onto the bare ground middles, belly rot became a common problem in mature fruit; at the same time, trellised vines continued to produce good quality fruit with little belly rot.

Costs and Returns. When the small plot yields in Table 1 were extrapolated to yields on a per-acre basis, the yield of Superselect cucumbers was 1,780 boxes per acre for the trellised plots versus 1,125 boxes per acre for non-trellised. Based on an average return to the grower of $7.55 per box of Superselect cucumbers for the month of July, the 655 boxes per acre gained from the trellised plots would have been worth an additional $4,952/acre, returning more than eight times the cost of trellising.

Table 1. Yields of market grades of 'Speedway' slicing cucumbers from trellised and non-trellised plots in McLean County, Kentucky, 2002. Data are combined yields from four replications of each treatment.

Market Grade	No Trellis	Single Strand	Double Strand
	boxes/plot		
Superselect	6	9	10
Select	10.5	9	10.5
Large (24 per box)	7	8	6
Small	3	2	2.5
Culls	5.5	3.5	3
Avg. harvest time for 200 plants	16 min.	17 min.	18 min.

Although this test needs to be repeated, we concluded that trellising did contribute to a better crop overall. Growers need to use this information with caution, however, as fewer benefits were observed from trellising in the cucumber variety trial at Lexington. In the Lexington trial, we also observed problems with spray coverage within the dense foliage of the trellised plantings and subsequently had more cucumber beetle feeding damage to fruits in those plots.

The grower-cooperators involved in this demonstration were happy with the results and plan to continue using the single-string trellis method, while another grower in the same county decided not to continue using trellises after having problems with spray coverage and damage from cucumber beetles. A few growers who tried trellising cucumbers in Central Kentucky this year reported that benefits were considerably greater in late summer plantings compared to spring plantings. Cucumber prices were moderate to high this year; had prices been lower, the extra material and labor costs of trellising may not have been justified.

Yield of Double-Cropped Cucumber Varieties for Fall Harvest in Western Kentucky

Clint Hardy, Brent Rowell, and John C. Snyder, Department of Horticulture

Introduction

Fresh market slicing cucumbers are becoming a major commercial vegetable crop in Western Kentucky. Cucumber production has increased in this area due to the strong marketing potential established through the West Kentucky Grower Cooperative. Since cucumber prices often rise in September and October, we wanted to evaluate nine different varieties in a late-summer planting. In addition, the trial was planted as a double crop after main season cucumbers to observe the feasibility of this technique.

Materials and Methods

Nine cucumber varieties were direct seeded on 7 August into old planting holes after plants from the previous crop had been removed. Glyphosate had been applied to burn down weeds and residues of the previous crop. The trial was conducted in a commercial grower's field near the co-op's packing facilities in western Daviess County. Drip tape from the previous crop was left in place and water was provided immediately after seeding in order to promote germination.

Black plastic mulch from the previous crop was painted white with a product called KoolGro®. KoolGro is formulated for use with plasticulture and is supposed to keep the area around the plants cooler than with unpainted black plastic. The trial was established as a randomized complete block design with four replications. Cucumbers were planted in double rows that were 18 inches apart with plants spaced 12 inches apart within the rows. Two seeds were sown in each planting hole; seedlings were later thinned so that 16 plants remained in each plot.

The plots had been fertilized prior to planting the previous crop. In addition, 10 lb N/A was fertigated weekly during the growing season. The crop was cultivated twice for weed control. Insecticides were applied as needed according to UK recommendations. Bravo was applied weekly, and Nova was applied twice for disease control. Ridomil Bravo was applied once. The plot was scouted once a week to monitor pests and diseases.

Results

Fungicide treatments were applied according to current recommendations; however, the cool and very rainy period that began in mid-September and continued through October resulted in serious plant and fruit losses from *Phytophthora capsici* that effectively ended the trial. This disease was prevalent in the portion of the grower's field where the trial was located after heavy rains occurred and standing water was observed. Ridomil Bravo was applied on 4 October and slowed subsequent development of the disease; however, severe fruit and plant losses had already occurred. This problem decreased quality and yield from the affected area in the trial field and resulted in much uncontrolled variability in the yield data collected. In addition, only four harvests were possible and yields were low (Table 1). Under these conditions, it was impossible to identify the best varieties with any confidence, and there were no statistically significant differences among varieties for most of the yield components measured (Table 1). We were also not able to detect any visible differences between the cucumbers in this trial on the white painted mulch and those in adjacent sections of the field that were grown on black plastic.

Table 1. Yields of fall-harvested, double-cropped cucumber varieties in Daviess County, Kentucky, 2002. Data are averages from four replications.

Variety	Seed Source	U.S. Fancy + U.S. No. 1[z]	Total Mkt.[y]
		boxes/acre	
Speedway	S	179	523
SRQ 2387	SS	171	476
Indy	S	164	330
Daytona	S	161	290
SRQ 2983	SS	136	267
EX4675898	S	131	425
Greensleeves	HM	115	206
Turbo	S	114	209
SRQ 2389	SS	105	397
Significance		NS	NS

[z] The combined yields of USDA grades Fancy and U.S. No. 1 are equivalent to the Superselect marketing category; yield expressed as number of 1 1/9 bu (55 lb) boxes/acre.

[y] Total marketable yield includes combined yields of U.S. Fancy, U.S. No. 1, U.S. No. 2, U.S. No. 1 Large, and U.S. No. 1 Small.

While double cropping on black plastic helps spread out the annual expense of plastic mulch, drip tape, and labor required for laying and removal, the labor costs for direct seeding by hand were high. In addition, the increased risk of serious disease problems in double-cropped cucurbits should be weighed carefully when considering this planting technique. We plan to repeat this trial for fall-harvested cucumbers in 2003.

Yield and Powdery Mildew Resistance of Fall-Harvested Summer Squash

Brent Rowell, William Nesmith, April Satanek, Darrell Slone, Janet Pfeiffer and John C. Snyder,
Departments of Horticulture and Plant Pathology

Introduction

Although squash from late summer plantings often achieve the highest market prices, fungal and virus diseases frequently cause serious damage in fall-harvested squash and are considered important barriers to profitable production in Kentucky and surrounding states.

Mixed virus infections commonly occur in fall-harvested summer squash in Kentucky. Watermelon mosaic virus (WMV, formerly WMV-2), zucchini yellow mosaic virus (ZYMV), squash mosaic virus (SqMV), cucumber mosaic virus (CMV), and papaya ringspot virus (PRSV, formerly WMV-1) have all occurred in Kentucky at one time or another and in most other southeastern states. Although the dominant virus(es) varies from site to site and from year to year, WMV has been the most frequently detected virus in summer squash (present in more than 90% of samples tested) during the last 11 years in Kentucky. Virus epidemics are often severe in late summer plantings and total destruction of the crop is not uncommon.

Effective virus resistance and tolerance were found among new transgenic (GMO) and conventionally bred cultivars tested in a fall-harvested trial in 1997 in Kentucky (see 1996-97 *Kentucky Vegetable Crop Research Report*). Although transgenic cultivars have become more popular with some growers since then, most yellow straightneck squash growers in Kentucky depend on cultivars with the precocious yellow (*Py*) gene for late-season production. These cultivars mask the greening effect in summer squash fruits when plants are infected by CMV or WMV but not if plants are infected by PRSV or ZYMV. In some areas, precocious yellow squash have reportedly been more difficult to market because of buyer preference for green, rather than yellow, fruit peduncles found in cultivars with the *Py* gene. Kentucky growers and marketers have not had difficulty marketing squash with this trait. Production of yellow crookneck squash, grown primarily in the southern part of Kentucky for southern markets, has been very risky without disease-resistant cultivars.

It was our intention to evaluate cultivars and breeding lines for yield and virus resistance in a fall-harvested trial. Because there was a near absence of virus diseases this year, cultivars and breeding lines were evaluated for marketable yield, powdery mildew (PM) resistance, and fruit appearance.

Materials and Methods

Thirty-four summer squash cultivars or advanced breeding lines (16 zucchini, nine yellow straightneck, and nine yellow semi-crookneck or crookneck entries) were evaluated at the University of Kentucky Horticultural Research Farm in Lexington in the late summer and fall of 2002. These included several of the best performing cultivars from the 1997 trial. Most cultural practices were according to our current commercial recommendations for Kentucky. Seeds were sown in the greenhouse on 18 July in 72-cell plastic trays and transplanted to the field on 6 Aug. Each plot consisted of eight plants spaced 18 inches apart in a single row on 6-inch high raised beds with white-on-black plastic mulch and drip irrigation. Beds were 6 ft apart from center to center. All 34 entries were planted together in a randomized complete block design with four replications. Cultivars of each type (zucchinis, yellow straightneck, or yellow crookneck) were grouped together within each block. Blocks consisted of two long rows with 16 or 17 entries per row. Single rows of the disease-susceptible cultivar Dixie were planted on both sides of each block to enhance natural disease buildup and uniform spread throughout the trial.

Sixty-five pounds N/A were applied prior to planting, while an additional 18 lb N/A were applied in three fertigations for a season total of 83 lb N/A. All P and K were applied preplant according to recommendations based on soil tests. Quadris was applied on Aug. 7, 14, and 30 for fungal disease control; a tank mix of Nova and Bravo was applied on Sept. 9 and 26. The systemic insecticide Admire was applied two days after transplanting as a post-transplant drench for cucumber beetle control. Two subsequent applications of Pounce were made for later season cucumber beetle and squash vine borer control.

Plots were harvested three days per week (MWF) from 27 Aug. until 4 Oct. for a total of 16 harvests. Fruits were counted and weighed after grading into either marketable fruit or culls. Marketable yield was expressed in terms of the number of half-bushel boxes per acre by dividing the total weight of marketable fruit per acre by 21 lb. Following an analysis of variance, average yields and disease ratings were compared using Waller-Duncan's K-ratio T-test ($P = 0.05$).

Fruit Quality Ratings. All fruits of each trial entry harvested from all four replications were graded and laid out on tables for careful examination and quality rating on 11 and 20 Sept. Fruits were assessed for type, color, and overall appearance. Yellow squash type (straightneck, semi-crookneck, or crookneck) was determined based on our own observations rather than seed company descriptions. Yellow squash color was rated on a 1 to 5 scale with 1 = pale yellow with greenish tint and 5 = bright golden yellow. Zucchini squash color was scored from 1 = light green to 5 = very dark green, nearly black. Appearance was rated on a 1 to 9 scale with 1 = worst and 9 = best taking into account, in order of importance: overall attractiveness, shape, uniformity of shape, and color.

Disease Assessments. Plants were visually assessed for the extent of PM symptoms on leaves (both upper and lower surfaces) and stems on 11 Sept. and 7 Oct. Although we did not identify PM species in this trial, mixtures of *Sphaerotheca fuliginea* and *Erysiphe cichoracearum* are usually found in late-summer squash plantings; both species were identified in the 1997 trial.

Results and Discussion

This harvest season was exceptional in that only a few of the more than 2,000 plants in the trial field showed any virus symptoms or yielded unmarketable fruits having virus symptoms. This was in spite of the presence of other cucurbit trials, which were planted earlier at the same location, and in spite of the extensive planting of a susceptible cultivar within the trial field. Commercial squash growers in Central and Western Kentucky also reported very low virus incidence in 2002. Midsummer drought led to a decline in clover and other host plants, and this may have resulted in the low virus incidence.

Yellow Straightnecks. As was the case in 1997, conventionally bred hybrids having the precocious yellow gene were in the highest yielding group of yellow straightneck squash cultivars: Sunray, Multipik, Fortune, and Monet were not significantly different from the highest yielding Precious II (Table 1). Multipik and Fortune were also in this highest yielding group in 1997 when virus incidence was high. While lower yielding, Cougar and Seneca Supreme had the best fruit appearance scores among straightnecks (Table 1).

Powdery mildew symptoms were first observed inside leaf canopies of some cultivars in mid-September. Sunray exhibited exceptional PM resistance, while Precious II also had PM resistance that was significantly better than the resistance of other cultivars in this group; Fortune and Multipik appeared to be the most susceptible to PM among the straightnecks tested (Table 1). In the absence of virus diseases, transgenic cultivars Conqueror III and Liberator III were the lowest yielding in the group and were susceptible to PM; these cultivars also had the lowest appearance scores (Table 1). Transgenics were among the highest yielders in 1997 when virus pressure was very high.

Yellow Crooknecks. While transgenic cultivars Prelude II and Destiny III were clearly superior among yellow crookneck entries in 1997 under intense virus pressure, only Prelude II was among the highest yielding crookneck

Table 1. Yields and powdery mildew assessments for yellow straightneck, crookneck, and zucchini squash cultivars, breeding lines; data are averages of four replications; appearance ratings are averages from two assessments of all fruits harvested from four replications.

Entry	Source	Type[z]	Mkt. Yield boxes/acre[y]	Powdery Mildew[x] 11 Sept.	7 Oct.	Avg.	Appearance Rating[w]
I. Yellow straightneck and slight semi-crookneck:							
Precious II	AC	SN-Py	1660	1.8	0.7	1.2	5.5
Sunray	S	SN/sCN-Py	1536	0.1	0.4	0.3	6.5
Multipik	HM	SN-Py	1526	3.0	3.7	3.4	6.5
Fortune	RG	SN-Py	1513	3.7	3.2	3.5	6.5
Monet	HM	SN-Py	1511	2.5	3.5	3.0	6.5
Goldbar	S	SN	1475	2.5	2.7	2.6	5.5
Cougar	HM	SN/sCN-Py	1369	2.6	2.7	2.7	7.0
Seneca Supreme	S	SN-Py	1327	2.6	2.7	2.7	7.0
Lioness	HM	SN	1281	2.7	1.0	1.9	5.0
Conqueror III	S	SN,Tg-3+	1262	2.6	2.5	2.6	4.5
Liberator III	S	SN,Tg-3	1219	3.0	3.2	3.1	4.0
II. Yellow semi-crookneck or crookneck:							
Medallion	AC	sCN/CN	1663	3.2	3.0	3.1	5.5
Sunglo	RG	sCN/CN	1495	0.2	0.5	0.4	5.5
Prelude II	S	CN	1462	0.0	0.1	0.1	5.5
Gentry	RG	sCN	1450	2.6	3.5	3.1	5.5
Dixie	S	CN	1384	3.9	3.5	3.7	5.5
Destiny III	S	sCN/CN,Tg-3	1267	3.5	3.5	3.5	6.0
Pic-n-Pic	SW	CN	1101	3.7	3.7	3.7	6.0
Waller-Duncan LSD (all yellow squash, P = 0.05).			*220*	*0.6*	*0.7*	*0.6*	---
III. Zucchini:							
HMX 710	HM	Z	1722	0.0	0.0	0.0	7.0
Zucchini Elite	HM	Z	1694	3.3	2.3	2.8	6.0
SVT 4620327	S	Z, Tg-3	1686	0.4	0.0	0.2	5.5
Cashflow	RG	Z	1635	4.2	4.2	4.2	6.5
Lynx	HM	Z	1567	4.0	2.7	3.4	5.0
Dividend	RG	Z	1517	3.5	3.0	3.2	6.0
Spineless Beauty	RG	Z	1466	4.0	3.0	3.5	5.5
9523	SS	Z	1445	4.3	4.3	4.3	6.5
Revenue	RG	Z	1276	3.5	3.5	3.5	5.5
Robuster	SS	Z	1262	4.0	4.4	4.2	5.5
Senator	S	Z	1215	3.2	2.2	2.7	6.0
AXC 34	AC	Z	1207	4.7	3.5	4.1	6.0
Tigress	HM	Z	1172	2.0	1.7	1.8	6.5
Independence II	S	Z,Tg-2	1146	4.0	2.5	3.2	5.0
Seasons	AC	Z	1130	4.5	4.0	4.2	5.0
ACX 45	AC	Z	1123	5.0	4.2	4.6	5.5
Waller-Duncan LSD (zucchinis, P = 0.05)			*326*	*0.6*	*1.3*	*0.7*	--

[z] All entries from conventional breeding programs except for: Tg = transgenic for resistance to two (Tg-2) or three (Tg-3) viruses; Tg-3+ = transgenic for three viruses with resistance to the fourth (PRSV) obtained through conventional breeding. Type descriptions based on our observations on 11 and 20 Sept.: SN = straightneck, CN = crookneck, sCN = semi-crookneck; some cultivars that we considered semi-crookneck are considered straightneck by the seed company and are included in the straightneck grouping; Py = has precocious yellow gene to mask virus symptoms.

[y] Number of half-bushel (21lb) boxes per acre.

[x] Visual rating scale: 0 = no symptoms, 5 = extensive symptoms on entire plants. Ratings took into account the percentage of upper and lower leaf and stem surfaces that were covered by powdery mildew symptoms; assessed by W. Nesmith on 11 Sept and 7 Oct (3 days after final harvest).

[w] Appearance ratings: 1 = worst, 9 = best, taking into account, in order of importance, overall attractiveness, shape, and color.

cultivars in 2002. Conventionally bred cultivars Sunglo and Gentry were also not significantly different in yields from the highest yielding Medallion among crooknecks (Table 1). Both Sunglo and Prelude II showed an exceptional degree of PM resistance, while the other cultivars in this group were much more susceptible (Table 1). Lower yielding Destiny III and Pic-N-Pic had the best appearance scores, while appearance scores for the other cultivars in this group were deemed acceptable (Table 2).

Zucchinis. One transgenic and six conventionally bred zucchini cultivars were in the highest yielding group that were not significantly different from highest yielding line HMX 0710; these included Zucchini Elite, SVT 04620327 (transgenic virus resistance), Cashflow, Lynx, Dividend, Spineless Beauty, and Sunseeds 9523 (Table 1). Dividend was also in the highest yielding group in 1997. As in 1997, the transgenic virus-resistant Independence II was among the lowest yielding zucchini cultivars. Appearance ratings were highest for HMX 0710, Cashflow, Sunseeds 9523, and Tigress; fruit from a single observation plot of Tigress also had high appearance ratings in 1997. Plots of both Tigress and Senator, however, had a single plant (of the 32 plants of each cultivar that were grown for the trial) that yielded off-type fruits. Zucchini Elite, Dividend, Senator, and ACX 34 also had good appearance ratings

Table 2. Fruit color, appearance, and other observations for yellow straightneck, crookneck, and zucchini squash cultivars and breeding lines; ratings are averages from two assessments (11 and 20 Sept 2002); all fruits bulked from four replications at each of the two harvests.

Entry	Type[z]	Color[y]	Appearance Rating[x]	Shape/Comments/Suitability
Precious II	SN-Py	2.7	5.5	Very long with long, thick neck; pale yellow w/greenish tint at blossom end; 50% curved.
Sunray	SN/sCN-PY	3.0	6.5	Elongated teardrop shape; very slight crook; good color.
Multipik	SN-Py	3.2	6.5	Long teardrop shape.
Fortune	SN-Py	3.0	6.5	Medium long teardrop shape; 20% curved.
Monet	SN-Py	3.5	6.5	Teardrop shape; nice color.
Goldbar	SN	2.0	5.5	Long w/very slight crook in most; greenish cast.
Cougar	SN/sCN-Py	3.0	7.0	Long teardrop shape; slight crook.
Seneca Supreme	SN-Py	3.0	7.0	Teardrop shape; attractive.
Lioness	SN	1.5	5.0	Long w/slight crooks; greenish cast in smallest fruits.
Conqueror III	SN	1.5	4.5	Very long, thin; 50% slightly curved; greenish cast.
Liberator III	SN	1.5	4.0	Very long, thin; 50% slightly curved; greenish cast.
Medallion	sCN/CN	3.5	5.5	Good color; medium thick neck.
Sunglo	sCN/CN	2.0	5.5	Medium thick neck; pale w/greenish cast.
Prelude II	CN	2.0	5.5	Medium thick neck; greenish cast.
Gentry	sCN	3.5	5.5	Medium thick neck; shape somewhat variable.
Dixie	CN	2.0	5.5	Thick neck; greenish cast.
Destiny III	sCN/CN	2.0	6.0	Medium thick neck; greenish cast.
Pic-N-Pic	CN	2.7	6.0	Thinner neck than most; greenish cast in smallest fruits.
HMX 0710	Z	3.0	7.0	Medium dark green; 50% w/slight curve and very slight taper (almost cylindrical.
Zucchini Elite	Z	3.0	6.0	Medium green; 50% w/slight curve; larger diam. Blossom end (slight taper).
SVT 04620327	Z	3.7	5.5	Medium dark green; 50% w/slight curve; many w/slight and occasionally uneven taper.
Cashflow	Z	3.0	6.5	Medium green; 40% w/slight curve; very slight taper.
Lynx	Z	3.7	5.0	Medium green; 60% w/slight to moderate curve; slight taper.
Dividend	Z	3.0	6.0	Light to medium green; 20% w/slight curve; slight taper, nearly perfectly cylindrical; very nice looking.
Spineless Beauty	Z	3.7	5.5	Medium dark green; angular fruit; mostly slightly curved and tapered (larger blossom end).
9523	Z	4.0	6.5	Medium dark green; most slightly curved; strong taper (larger blossom end); attractive glossy color.
Revenue	Z	3.0	5.5	Light to medium green; slightly larger blossom end; most slightly curved.
Robuster	Z	3.0	5.5	Medium green; 20% curved w/very slight taper.
Senator	Z	2.5	6.0	Light to medium green; heavily speckled; most slightly curved with smooth taper; one plant with off-type fruits in this trial.
AXC 34	Z	3.0	6.0	Light to medium green; mostly slightly curved w/very slight taper.
Tigress	Z	2.0	6.5	Gray-green speckled; 50% slightly curved; tapered; one plant with off-type fruits in this trial.
Independence II	Z	2.7	5.0	Medium green; most fruits slightly curved and tapered.
Seasons	Z	4.2	5.0	Medium dark green; 40-50% slightly curved, straight to very slight taper; shape not uniform.
ACX 45	Z	4.7	5.5	Very dark green; most slightly curved; no taper.

[z] Type descriptions based on our observations on 11 and 20 Sept. (SN = straightneck, SN-Py = straightneck with precocious yellow gene, CN = crookneck, sCN = semi-crookneck); some cultivars that we considered semi-crookneck may be considered straightneck by the seed company.
[y] Color ratings for yellow squash: 1 = pale yellow with greenish tint; 5 = bright golden yellow; for zucchini, 1 = lightest green; 5 = nearly black.
[x] Appearance ratings: 1 = worst; 9 = best, taking into account, in order of importance, overall attractiveness, shape, and color.

(Tables 1 and 2); Zucchini Elite, Dividend, and Senator had high scores in the 1997 trial.

PM resistance was exceptionally high in breeding lines HMX 0710 (no symptoms) and SVT 04620327; Tigress also appeared to be resistant or tolerant to PM. PM ratings were significantly lower for HMX 0710, SVT 04620327, and Tigress than for the other zucchini cultivars. Neither of the two numbered breeding lines had been named/released at the time of this writing.

Results from the 1997 fall-harvested trial at this location together with those from similar trials in other states demonstrated that transgenic virus-resistant squash cultivars could provide excellent resistance to two or more of the viruses involved in mixed infections in the southeastern United States. Transgenic zucchini line SVT 04620327 and transgenic crookneck Prelude II both have high levels of PM resistance and performed well in this trial; the other transgenic cultivars did not perform as well in 2002 in the absence of significant virus pressure and under epidemic powdery mildew conditions.

Marketable yields in late plantings can be expected to vary considerably among cultivars from year to year and location to location depending on the resistance package in the cultivar, diseases present in the field, and the growth stage at which the crop becomes infected. Precocious yellow straightneck cultivars remain an excellent choice for high yields and masking of green fruit symptoms associated with moderate epidemics of WMV and CMV. New straightneck cultivars Precious II, Sunray, Monet, and Cougar are recommended for small-scale trial by growers;

Sunray and Precious II should provide valuable levels of PM resistance. Fortune and Multipik will remain on our list of suggested cultivars for Kentucky growers in spite of their susceptibility to PM. While lower yielding in this trial, transgenic virus resistant cultivars should perform considerably better in most late-summer plantings when virus diseases are serious risks for growers.

New crookneck cultivars Medallion and Sunglo are recommended for grower trial. Prelude II will remain the only transgenic crookneck on our list of suggested cultivars. New standouts among zucchinis recommended for grower trial are HMX 0710 (not yet released) for its high yields of attractive fruits and exceptional PM resistance. Cashflow, SVT 04620327 (not released), Lynx, and Sunseeds 9523 are also recommended for growers' trials. High levels of PM resistance are now available in cultivars of all three types of summer squash grown in Kentucky. PM resistance should be considered together with virus resistance, fruit appearance, and other horticultural characteristics in selecting cultivars for late-summer production.

Pumpkin Cultivar Trial, Eastern Kentucky

Terry Jones, Department of Horticulture

Introduction

As a fall crop, pumpkins allow Kentucky growers to extend their marketing season and take advantage of labor used to cut and house tobacco. Both wholesale and direct market pumpkin acreage has increased dramatically during the past five years. Howden has been the predominate cultivar grown for jack-o'-lantern sale. However, problems with fruit set during high temperatures and Fusarium fruit rot have created a need for better cultivars.

A pumpkin cultivar trial was conducted at the University of Kentucky Robinson Station, Quicksand, Kentucky. Ten cultivars, two of which were small or miniature pumpkins, were evaluated in replicated plots.

Methods

Seeds were planted directly in the field on June 18, 2002. Each cultivar was replicated four times in a randomized complete block design. Each replication consisted of a single row 20 ft long containing 10 plants (two/hill). Seeds were hand-sown 4 ft apart in the row with 14 ft between rows. The seed was planted about 1 inch deep. A total of 500 lb of 5-20-20/A was applied preplant. Fifty pounds per acre of N (ammonium nitrate) was applied as a sidedressing two weeks after planting. A second sidedressing of ammonia nitrate was applied when the vines began to run, bringing the total nitrogen applied to 125 lb actual N/A. Command 4EC (1 pt/A) was applied preplant and incorporated. Curbit 3EC at 2 qt/A was applied immediately after planting. Pest control sprays were applied during the growing season for disease and insect problems as conditions warranted. Overhead irrigation was applied as needed. Growing conditions during the season were hot and dry.

Results and Discussion

Pumpkin yields were very good for a hot, dry year (Table 1). None of the eight standard pumpkin cultivars showed any significant difference in fruit number. Appalachian, Gold Standard, Magic Lantern, and Pro Gold 510 all had more than 3,000 fruit per acre. Autumn King, Jumpin Jack, Gold Strike, and Gold Gem had closer to 2,000 fruit per acre. The highest yielding (lb/A) large jack-o'-lantern in the trial was

Table 1. Seed source, fruit number per acre, yield, average weight, and quality evaluations for pumpkin cultivars, Quicksand, 2002.

Cultivar	Seed Source	Fruit No./A[1]	Yield (lb/A)[1]	Avg. Wt. (lb)[1]	Shape[2]	Smooth[3]	Ribbing[4]	Color[5]	Stem Quality[6]	Stem Color[7]
Touch of Autumn (RWS-6260)	RG	8,517 A	16,510 DE	1.9 D	3	4	3	LO	3	DG
Baby Bear	RU	6,145 B	7,106 E	1.2 D	3	4	3	MO	2	DG-T
Appalachian	PS	3,461 C	52,440 A	14.9 AB	1.8	2.8	2.3	DO	2.3	L-DG
Gold Standard	RU	3,306 C	36,250 BC	11.1 C	2.8	2.5	2.3	DO	3	MG
Magic Lantern	HM	3,228 C	42,580 AB	13.1 ABC	3	4.3	1.5	MO	2.5	MG
Pro Gold 510	RU	3,034 C	43,710 AB	15 A	1.5	3.5	4.3	LO	2	MG
Autumn King	RG	2,411 C	30,820 BC	12.7 BC	1.8	3	2.5	MO	2.5	DG-T
Jumpin Jack	RU	2,334 C	29,910 BCD	12.9 ABC	1.8	3	3.3	LO	1.5	T
Gold Strike	RU	2,061 C	30,750 BCD	14.2 AB	1.5	1.8	1.5	DO	1.8	DG-T
Gold Gem (Rex 38041)	RU	1,945 C	26,550 CD	13.8 AB	2.8	2.3	1.8	M-DO	1.8	T
LSD[8]		1,543	14,300	2.2						

1 Means followed by the same letter are not significantly different as determined by LSD (P = 0.05%).
2 1 = oblate or flat, 2 = blocky, 3 = round.
3 1 = rough, warty skin, 5 = very smooth.
4 1 = heavy ribbed, 5 = no ribbing, smooth.
5 lo = light orange, mo = medium orange, do = dark orange, ro = reddish orange, w = white.
6 1 = weak, small, breaks off; 3 = strong and large.
7 lg = light green, mg = medium green, dg = dark green, t = tan.
8 Least Significant Difference (P = 0.05).

Appalachian. Magic Lantern and Pro Gold 510 also produced well. Gold Gem produced the fewest pounds per acre and had the fewest fruit per acre. Pro Gold 510 had the largest fruit size. Touch of Autumn produced significantly more fruit and pounds per acre than Baby Bear. Both were attractive, nicely shaped miniature pumpkins. Appalachian, the best producing jack- o'-lantern in this trial, produces fruit on bush vines, which would allow for a much closer row spacing than that used in this trial. Gold Standard, a slightly smaller pumpkin, has consistently produced good yields of attractive fruit that are a nice size for school children. Magic Lantern, because of its resistance to powdery mildew, has potential for growers who follow a reduced spray program or do not own a good, high-pressure sprayer.

Yield of New Muskmelon Cultivars in Eastern Kentucky

William Turner, Charles Back, and R. Terry Jones, Department of Horticulture

Introduction

Eastern cantaloupe has been identified as one of several profitable crops that Kentucky farmers can produce. Potential yields of 8,000 to10,000 fruit per acre, with gross returns of $5,000/A are possible. Variable costs are roughly $1,000 per acre, and net returns to the grower are in the $2,200 range. One farm cooperative, several grower marketing associations, and numerous farmers' market producers are currently producing cantaloupes for fresh market sales. This cultivar trial compares Athena, which is currently produced on 75% of all Eastern cantaloupe acreage, with five other cultivars that produce similar fruit. Six cantaloupe cultivars were compared to determine yield and size and for potential use by Kentucky growers for wholesale, roadside, and farmers' markets.

Materials and Methods

Cantaloupe seeds were planted in plug trays and grown in the greenhouse for four weeks before transplanting through black plastic on 28 May 2002. Cultivars were planted in a randomized complete block. There were four replications with five plants per replication. Each replication was 15 ft long with plants set 3 ft apart in the row. Rows were 7 ft on center.

A total of 150 pounds of nitrogen was applied through drip lines as either ammonium or potassium nitrate. Curbit 3E (1 qt/A) and Gramoxone Extra (2pt/A) were applied for weed control between the mulched beds one week after transplanting. An additional spot spray was made 14 days later to improve control. Admire 2F at the rate of 24 fl oz/A was applied as a drench just after transplanting, using a backpack sprayer with the nozzle removed. Either mancozeb or chlorothalonil was applied weekly, and Quadris was applied on alternate weeks during July and August. Endosulfan 3EC or Pounce 3.2EC was applied for insect control when needed.

Following harvest, cantaloupes were sold through a local produce stand. The owner observed customer reactions to the various melons and reported buyer preferences and comments when he came to obtain more melons. He also began selecting only those melons that his customers wanted.

Results

There were no significant differences in fruit number per acre for the six cultivars (Table 1). The average fruit weight of Athena was less than those of the other five cultivars. Odyssey, the highest yielding cultivar in the trial, produced significantly more cwt/A than Athena. The yields of the other four cultivars were not different from that of Odyssey or Athena. The appearance of Odyssey was very similar to that of Athena, except it was larger. Vienna fruit were not as attractive as those of the other cultivars and tended to have more cracking around the stem end. All six muskmelon cultivars produced marketable fruit. At a roadside market Minerva, Eclipse, and RML 8793VP were the first to sell. These are large, attractive melons that look like the Indiana melon that consumers wanted. Unfortunately, they are softer and do not store or ship as well as Athena. Athena and Odyssey also sold well as long as they had good size (larger than 5 lb). Vienna sold only if nothing else was available. None of the new cultivars tested is

Table 1. Maturity, seed source, average fruit weight, number of fruit per acre, yield, and shape and appearance evaluations for six muskmelon cultivars, Quicksand, 2002.

Cultivar	Days to Maturity*	Seed Source	Avg. Wt. (lb/fruit)[1]	Marketable Fruit/A[1]	Yield (cwt/A)[1]	Comments (Shape and Appearance)
Eclipse	63	SW	8.1 A	5906 A	480 AB	large size, good taste and quality, local sales
Odyssey	65	SU	8.2 A	6327 A	519 A	heavy netted, shallow sutures, holds & ships well
Vienna	63	SW	8.15 A	5082 A	415 AB	medium shelf life, cracks
RML 8793VP	63	SW	8.8 A	4978 A	439 AB	large, attractive, similar to Minerva, local sales
Athena	63	SW	6.5 B	5393 A	351 B	firm flesh, good shipper
Minerva	65	SW	8.6 A	4978 A	426 AB	large, very attractive fruit, local sales
LSD[2]			1.2	2245	146	

* Day from transplanting to first fruit harvested.
1 Means, within a column, followed by the same letter, are not significantly different as determined by LSD (P 0.05).
2 Least Significant Difference, P = 0.05.

likely to replace Athena in the commercial wholesale market because produce buyers demand that particular melon. Odyssey might be mixed with Athena to improve overall fruit size.

Specialty Melon Variety Observation Trial

John Strang, April Satanek, Chris Smigell, Dave Lowry, and Phillip Bush, Department of Horticulture

Introduction

This trial was designed to screen 19 different specialty melon varieties under Kentucky growing conditions. Honeydew, galia, casaba, muskmelon, charentais, and specialty hybrid melons were evaluated in this trial.

Materials and Methods

All varieties were seeded on April 25 into cell packs (72 cells per tray) at the Horticulture Research Farm in Lexington. Cell packs were set on a mist bench with bottom heat until seeds germinated, then moved to a drier, cooler bench in the greenhouse, where the seedlings were thinned to one per cell. Plants were set into black plastic-mulched, raised beds using a waterwheel setter on May 29 and May 30. A single plot of each variety was planted. Each was 36 ft long, with 12 plants set 3 ft apart within the row and 6 ft between rows. Drip irrigation provided water and fertilizer as needed.

Fifty pounds N/A as ammonium nitrate were applied and incorporated into the field prior to bed shaping and planting. The plot was fertigated with a total of 60 lb N/A as ammonium nitrate divided into eight applications. The systemic insecticide Admire 2F was applied as a drench to the base of each plant after planting, using the maximum rate of 24 fl oz/A. Foliar insecticide applications during the season included Sevin and Pounce. Fungicide applications included a pre-plant application of Ridomil Gold and foliar applications of Bravo and Quadris. Curbit preemergent herbicide was applied and incorporated between the rows, just as the vines began to grow off the plastic mulch. Two average-sized fruit of each variety were measured and evaluated for flavor, soluble solids, interior color, and rind color as each variety reached harvest maturity.

Results and Discussion

Admire 2F helped to reduce the number of early cucumber beetles. The growing season was marked with rainy, cool periods, followed by hot, dry periods. The dry weather helped to reduce plant and fruit disease severity, although diseases became more destructive mid- to late season. Very little virus was observed in the plot. Vine cover was thick, with little plant death. Fruit were generally harvested twice a week, more often at the beginning of the harvest period due to the rapid ripening of the galia melons. The weather proved beneficial to most melon varieties. Although the charentais melons did not split as rapidly or as severely as in last year's trial, a considerable amount of fruit was culled due to small cracks.

Honeydews

Honey Dew Green Flesh, Honey Pearl, and San Juan all looked good in this evaluation. All had excellent eating quality and low cull numbers. Honey Pearl had a cream-colored flesh, while the other two varieties had light green flesh. Honey Dew Green Flesh melons were large, averaging 5.6 lb per fruit, while Honey Pearl and San Juan were smaller melons weighing 3.9 lb and 3.7 lb per fruit, respectively. Honey Pearl produced a second crop of quality melons (Tables 1 and 2).

Galia Melons

Arava and Sweet Dreams were the best galia melons. Both had excellent eating quality. Arava was judged to have a more attractive exterior and was slightly smaller than Sweet Dreams. It also had very low cull numbers (Table 1). Galia melons must be harvested as soon as the rind starts to turn yellow. Otherwise, the melons rapidly become overripe and are unmarketable. After the initial melon set was harvested, most varieties continued producing fruit, although the number harvested decreased.

Charentais

Four charentais melon varieties were evaluated. None of these performed well in this trial (Tables 1 and 2). It is difficult to visually determine the correct harvest time for charentais melons. Suggested harvest maturity criteria include the yellowing and wilting of the leaf nearest the fruit stem, a change in the rind color from green to grey, and softening of the blossom scar. None of these maturity cues aided in proper harvest timing for this trial. The fruit were mostly either immature or split and decayed when following these criteria.

Miscellaneous melon types

Marygold, a casaba melon, performed very well. It had excellent eating quality and very low numbers of culls. Vanilla Ice, a specialty hybrid melon, was found to have excellent flavor when it was evaluated at the first harvest, but the flavor varied in subsequent harvests. Vanilla Ice melons were not very attractive and had a very short shelf life. HSR 4122, a netted western type cantaloupe, produced well but was not of outstanding quality (Tables 1 and 2).

Acknowledgments

The authors would like to thank Larry Blanford, Barry Duncil, Justin Clark, Stephanie Goode, Courtney Bobrowski, Witoon (Toon) Jaiphon, Sopon (Toni) Issaravut, Takanobu (Bell) Suzuki, Darren Taylor, Eric Bowman, and Spencer Helsabeck for their help with this trial.

Table 1. Specialty melon fruit characteristics from single plots, Lexington, Kentucky, 2002.

Variety	Melon Type[1]	Seed Source	Days to Harvest	Yield[2] (cwt/A)	Avg. No. Melons/A	Avg. Wt./Fruit (lb)	Culls (%)	Exterior Fruit Length (in.)	Exterior Fruit Width (in.)	Flesh Thick. (in.)	Seed Cavity Length (in.)	Seed Cavity Width (in.)
Honey Dew Green Flesh	HD	RU	90	797.1	14300	5.6	0	8.9	7.3	1.6	5.8	3.9
HSR 4156	HD	HL	90-95	765.8	13700	5.6	0	7.5	7.1	1.9	4.4	3.0
Fantasma	HD	HM	85	663.0	9300	7.1	13.2	8.7	7.7	2.1	5.5	3.5
Honey Pearl	HD	JS	80	631.2	16300	3.9	2.4	7.4	6.7	1.9	4.2	3.0
Morning Ice	HD	HM	85	479.0	6900	7.0	27.6	9.1	7.3	2.0	6.0	3.3
San Juan	HD	RU	75	476.0	12900	3.7	4.4	6.5	6.3	1.8	4.0	2.8
HSR 4054	GA	HL	85	635.3	11900	5.3	3.2	7.2	6.8	2.0	4.6	2.7
HSR 4036	GA	HL	70	559.1	11700	4.8	3.3	7.0	6.4	1.9	4.2	2.6
Arava	GA	JS	77	545.0	12300	4.4	3.1	6.7	6.8	1.8	4.0	3.0
Sweet Dreams	GA	SW	79	412.4	6300	6.6	13.8	7.9	7.2	2.0	4.4	3.1
Passport	GA	HL	75	375.7	7100	5.3	10.2	6.8	6.5	2.0	3.9	2.5
Crete	GA	ST	88	300.0	6500	4.6	5.8	7.4	6.6	1.9	4.7	2.8
Honey Girl Hybrid	CH	BU	75	388.2	9900	3.9	24.6	6.4	6.4	1.5	3.7	3.1
French Orange	CH	HR	75	359.5	12300	2.9	24.6	5.6	5.2	1.5	3.4	2.2
Savor	CH	JS	78	152.3	7100	2.2	45.3	5.4	5.6	1.5	3.2	2.5
Edonis	CH	JS	70	94.3	3200	2.9	71.4	6.6	5.9	1.7	4.1	2.3
Marygold	CS	RU	92	615.6	16500	3.7	1.2	7.3	6.0	1.6	4.5	3.0
Vanilla Ice	SH	BU	80	660.5	13500	4.9	5.6	6.9	6.7	1.9	4.3	3.0
HSR 4122	MM	HL	80-95	441.7	11100	4.0	1.1	6.5	6.2	1.8	4.0	2.8

1 Melon type: HD = honeydew, GA = galia, CS = casaba, CH = charentais, SH = specialty hybrid, MM = muskmelon.
2 Cwt = hundreds of pounds per acre.

Table 2. Specialty melon fruit and vine characteristics from single plots, Lexington, Kentucky, 2002.

Variety	Flavor (1-5)[1]	Sugar (%)	Flesh Color[2]	Rind Color[3]	Fruit Shape	Cracking (1-4)[4]	Net Type[5]	Comments
Honey Dew Green Flesh	4.3	12.6	lg	lg/cr	oval	1	na	Doesn't slip, firm flesh.
HSR 4156	3.3	10.0	cr-lg	lg/cr	oval	1.5	na	Doesn't slip, uniform, attractive exterior, minimal checking.
Fantasma	4.0	12.6	lg	wh/gr	oval	1	na	Doesn't slip, attractive, oddly shaped.
Honey Pearl	4.0	13.2	cr	cr/wh	oval	1	na	Doesn't slip, attractive, has a few small, light yellow spots when ripe, very good taste, large second set of high quality melons.
Morning Ice	4.3	13.4	cr-lg	lg	oval	1	na	Doesn't slip, surface checking near stem, not uniform in shape.
San Juan	4.0	15.5	lg-gr	lg/cr	round	1	na	Doesn't slip, small melon, nice, sweet flavor.
HSR 4054	3.3	10.5	lg-gr	gr/yl	oval	1.5	md	Stem slips when ripe, some variability in fruit size and shape.
HSR 4036	3.4	9.0	lg-gr	gr/yl	oval	1	lt	Stem slips when ripe, yellow rind indicates ripeness, attractive exterior and interior.
Arava	4.5	10.4	lg-gr	yl/gr	round	1.5	md	Stem slips when ripe, very attractive.
Sweet Dreams	4.3	12.3	lg	gr/yl	oval	1.5	lt	Stem slips when ripe, consistent quality.
Passport	3.2	7.3	cr-gr	gr/yl	oval	2	md	Stem slips when ripe, attractive exterior and interior.
Crete	3.5	12.8	ly-gr	gr/yl	oval	1	md	Stem slips hard and fruit still green when ripe, quality not consistent.
Honey Girl Hybrid	4.0	10.8	do	tn w/sutures	round	1	na	Pick at half slip, taste is distinctive.
French Orange	4.5	11.5	do	tn	round	1	md	Pick at half slip, consistent taste.
Savor	3.4	11.0	do	tn w/sutures	round	3.5	na	Pick at half slip, cracked severely and split open.
Edonis	3.8	11.4	do	tn/gr w/sutures	round	3	lt	Pick at half slip, cracked severely at blossom end.
Marygold	4.0	12.9	cr	dy	oval	1	na	Doesn't slip, slight checking.
Vanilla Ice	5.0	12.1	ly	gr/yl	round	1	lt	Stem slips when ripe, mature when green and yellow speckled, slight surface checking, good flavor, variable quality among harvests.
HSR 4122	3.8	10.6	or	tn	round	1	md	Stem slips when ripe.

1 Flavor: 1 = poor, 5 = excellent sweet taste, pleasant texture.
2 Flesh color: lg = light green, cr = cream, or = orange, do = dark orange, gr = green, ly = light yellow.
3 Rind color: lg = light green, gr = medium green, cr = cream, or = orange, yl = yellow, dy = dark yellow, tn = tan, wh = white.
4 Cracking: 1 = little or no cracking, 4 = severe cracking and fruit splitting.
5 Net type: lt = light netting, md = medium netting, hv = heavy, raised netting, na = none.

Specialty Melon Variety Evaluation

John Strang, April Satanek, John Snyder, Phillip Bush, Chris Smigell, and Dave Lowry, Department of Horticulture

Introduction

Fifteen specialty melon varieties were evaluated in this trial. These included ananas, Christmas, honeydew, galia, canary, Sicilian, Piel de Sapo, and specialty hybrid types of melons. This trial was designed to evaluate a number of different specialty melons under Kentucky conditions.

Materials and Methods

All varieties were seeded on April 25 into cell packs (72 cells per tray) at the Horticulture Research Farm in Lexington. Cell packs were set on a mist bench with bottom heat until seeds germinated, then moved to a drier, cooler bench in the greenhouse, where the seedlings were thinned to one per cell. Plants were set into black plastic-mulched, raised beds using a waterwheel setter on May 29. Each plot was 21 ft long, with seven plants set 3 ft apart within the row and 6 ft between rows. Each plot was replicated four times in a randomized complete block design with 6 ft between replications. Drip irrigation was used to provide water and fertilizer as needed.

Fifty pounds N/A as ammonium nitrate were applied and incorporated into the field prior to bed shaping and planting. The plot was fertigated with a total of 60 lb N/A as ammonium nitrate divided into eight applications over the season. The systemic insecticide Admire 2F was applied to the base of each plant as a drench treatment the day after planting, using the maximum rate of 24 fl oz/A. Foliar insecticide applications during the season included Sevin and Pounce. Fungicide applications included a preplant application of Ridomil Gold, and foliar applications of Bravo and Quadris. A pre-emergent herbicide, Curbit was applied and incorporated between the rows as the vines began to grow off the plastic mulch. One fruit from each replication was measured and evaluated for flavor, soluble solids, interior color, rind color, and net type.

Results

The use of Admire 2F helped to reduce the number of early cucumber beetles. Early in the season, cool, rainy weather prevailed, and this was followed by hot, dry periods. The dry weather helped to reduce the severity of some diseases, although disease became more destructive mid- to late season. Very little virus was observed in the plot. Early vine cover was thick, with little plant death. Plants were generally harvested twice a week, more often at the beginning due to the quick ripening of the galia and ananas type melons.

Honeydew type

Sundew and Honey Brew performed very well. These melons were also two of last year's best performers, with high yield (Table 1) and high sugar (Table 2). Sweet Delight also performed well, but it produced some oddly shaped fruit, making it less marketable. This season the honeydews exhibited less surface checking and developed a slight yellow blush when fully ripe.

Christmas type

The Christmas type melons in this trial were St. Nick and Sweet Barcelona. Although Sweet Barcelona had the higher yield, St. Nick had a more desirable flavor as well as a higher sugar content (Table 2). These are large melons averaging more than 10 pounds, and they have a distinctive taste as well as a very crisp, white flesh. For storage, Christmas melons should be harvested before slip. Slight checking of the surface was observed at maturity.

Canary type

Golden Beauty and Dorado were both excellent melons, and marketable yields were identical (Table 1). Dorado was slightly smaller than Golden Beauty and was judged to taste slightly better than Golden Beauty (Table 2); however, Golden Beauty did not produce any cull melons. Both varieties had excellent quality, were very attractive, and were observed to store for an extended period under refrigeration and to maintain eating quality.

Ananas type

Three ananas type melons were evaluated, HSR 4002B, HSR 2528, and Dove. Yield was about the same for all three varieties (Table 1). None of the ananas melons were judged to perform well in these trials. These varieties also ripen rapidly and were prone to decay if not picked promptly.

Miscellaneous melon types

Sapomiel, a Piel de Sapo melon, performed very well. It was attractive, similar to a Christmas melon, and had an excellent flavor. Sweet Dreams, a galia type melon, had an excellent taste and high sugar content. This is an excellent quality melon for local sales; however, the exterior is not as attractive as we would like. Branco Perfecto, a Sicilian melon, looked very much like a honeydew, except it had the wrinkly skin characteristic of a canary melon. Branco Perfecto did not have the exceptional sugar content and eating quality that we would like. The two specialty hybrid melons, Gourmet and HSR 4011, both ripened rapidly and had an off-flavor, particularly if they were a little overripe.

Acknowledgments

The authors would like to thank Darrell Slone, Larry Blanford, Barry Duncil, Justin Clark, Stephanie Goode, Courtney Bobrowski, Witoon (Toon) Jaiphong, Sopon (Toni) Issaravut, Takanobu (Bell) Suzuki, Darren Taylor, Eric Bowman, and Spencer Helsabeck for their help with this trial.

Table 1. Specialty melon variety trial yield and fruit characteristics, Lexington, Kentucky, 2002.

Variety	Melon Type[1]	Seed Source	Days to Harvest	Yield (cwt/A)[2]	Avg. No. Melons/A	Avg. Wt./Fruit (lb)	No. Melons/A Culls	Outside Measurements Length (in.)	Outside Measurements Width (in.)	Flesh Thick. (in.)	Seed Cavity Length (in.)	Seed Cavity Width (in.)
Sundew	HD	SS	85	747.1 a	10900	6.9	173	8.5	7.8	1.8	5.6	4.0
Honey Brew	HD	AC/RU	90	714.4 ab	10100	7.1	432	9.4	7.4	1.9	6.2	3.7
Sweet Delight	HD	RU	90	704.4 ab	9000	7.8	86	8.9	7.8	1.7	5.8	4.6
Sweet Barcelona	CR	BU	84	739.7 ab	6800	10.8	346	14.1	8.3	2.0	10.0	4.0
St. Nick	CR	HR	84	668.3 abc	6600	10.2	346	10.5	7.8	2.4	7.1	3.4
Golden Beauty	CA	JS	80	654.8 abc	9700	6.8	0	10.3	7.4	1.8	7.1	3.8
Dorado	CA	HR	85	654.3 abc	10600	6.2	432	9.5	7.0	1.9	6.4	3.4
HSR 4002B	AN	HL	95-100	580.4 abcd	10400	5.6	432	7.9	6.9	1.7	4.9	3.3
HSR 2528	AN	HL	95	547.9 bcd	10200	5.4	432	8.2	6.6	1.7	5.5	3.5
Dove	AN	HL	75	508.1 cd	10400	4.9	1210	6.8	6.4	1.7	4.0	3.0
Branco Perfecto	SC	SW	92	637.0 abc	7900	8.1	432	9.4	7.3	1.7	5.8	3.7
Sapomiel	PD	UG	94	586.2 abcd	8100	7.2	346	10.8	7.7	1.8	7.6	4.0
Sweet Dreams	GA	SW	79	493.7 cd	7300	6.8	1815	7.7	7.4	2.2	4.3	3.0
Gourmet	SH	HL	73	547.6 bcd	9900	5.6	1988	8.0	7.1	1.9	5.1	3.4
HSR 4011	SH	HL	75-80	417.8 d	7300	5.8	2506	7.0	7.0	1.9	3.5	3.1

1 Melon type: HD = honeydew, CR = Christmas, CA = Canary, SC = Sicilian, PD = Piel de Sapo, AN = ananas, GA = galia, SH = specialty hybrid.
2 Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05). Cwt = hundreds of pounds per acre.

Table 2. Specialty melon trial fruit characteristics, Lexington, Kentucky, 2002.

Variety	Flavor (1-5)[1]	Sugar (%)	Interior Color[2]	Rind Color[3]	Fruit Shape	Cracking (1-4)[4]	Net Type[5]	Comments
Sundew	4.5	12.8	cr-lg	lg	oval	1	na	Doesn't slip, attractive exterior and interior.
Honey Brew	4.4	12.5	cr-lg	lg	oval	1.25	na	Doesn't slip, some surface checking.
Sweet Delight	4.4	12.9	cr-lg	lg	oval	1	na	Doesn't slip, some oddly shaped, attractive interior.
Sweet Barcelona	2.6	10.4	cr-lg	dg w/yl streaks	oblong	1	na	Doesn't slip, coarse surface checking, distinctive exterior.
St. Nick	4.3	13.2	cr-wh	dg w/lg streaks	oblong	1	na	Slips at full/over maturity, harvest before slip for storage, light surface checks, crisp flesh, distinctive exterior.
Golden Beauty	4.3	13.4	cr-lg	dy	oblong	1	na	Doesn't slip, very attractive, wrinkled exterior, harvest when dark yellow.
Dorado	4.6	14.5	cr	dy	oblong	1	na	Doesn't slip, attractive interior and exterior, harvest when dark yellow.
HSR 4002B	3.0	9.9	lo	tn	oblong	1	md	Stem slips when ripe, attractive.
HSR 2528	2.9	8.9	cr	tn	oval	1	lt	Stem slips when ripe, attractive interior and exterior.
Dove	3.4	10.7	cr	tn	oval	1.3	lt	Stem slips when ripe, becomes overripe very quickly, must be harvested at first sign of exterior yellowing.
Branco Perfecto	4.0	11.6	cr	lg	oblong	1	na	Doesn't slip, wrinkly exterior, slightly pink cavity walls.
Sapomiel	4.5	13.8	cr	dg w/yl streaks	oblong	1	na	Doesn't slip, surface checks, large fruit, attractive exterior.
Sweet Dreams	4.6	12.8	lo-cr	gr/yl	oval	1.5	lt	Stem slips when ripe, becomes overripe very quickly, coarse netting, distinctive exterior, attractive interior, must be harvested at the first sign of exterior yellow.
Gourmet	3.8	10.6	cr	tn	oval	1.5	md	Stem slips when ripe, becomes overripe very quickly, attractive exterior, must be harvested at the first sign of exterior yellow.
HSR 4011	3.9	11.0	cr-wh	lg/yl	round	1.5	lt	Stem slips when ripe, coarse netting, distinctive exterior, small seed cavity.

1 Flavor: 1 = poor, 5 = excellent, sweet taste, pleasant texture.
2 Interior color: lo = light orange, cr = cream, lg = light green, wh = white.
3 Rind color: lg = light green, gr = green, dg = dark green, yl = yellow, dy = dark yellow, tn = tan.
4 Cracking: 1 = little or no cracking, 4 = severe cracking and fruit splitting.
5 Net type: lt = light netting, md = medium netting, hv = heavy raised netting, na = none.

Seeded and Seedless Watermelon Variety Trial

John Strang, April Satanek, John Snyder, Darrell Slone, Dave Lowry, and Phillip Bush, Department of Horticulture

Introduction

Seventeen triploid (seedless) and 10 seeded watermelon varieties were evaluated in this trial. One orange and several golden and yellow fleshed varieties were also included.

Materials and Methods

All varieties were sown in cell packs (72 cells/tray) on April 25. Trays were placed on a bench with bottom heat in a warm greenhouse. Once seeds had germinated, the seedlings were counted to obtain a germination percentage. The seedlings were then thinned to one per cell, and the trays moved to a slightly cooler house. On June 10, the watermelon plants were set into raised, plastic mulched beds using a water wheel setter. Each plot was 24 ft long, containing six plants, with 4 ft between plants within the row. Between row spacing was 10 ft. Each plot was replicated four times in a randomized complete block. Drip irrigation was used to irrigate and fertigate as needed.

Fifty pounds N/A as ammonium nitrate was applied preplant. A total of 47 lb N/A as ammonium nitrate was fertigated over seven applications throughout the season. Irrigation was halted about four weeks before harvest to increase melon sugar levels.

A systemic insecticide, Admire 2F, was applied as a drench to the base of each plant soon after planting, at the rate of 24 fl oz per acre. The foliar insecticide Sevin was also used for insect control. Fungicide sprays included a soil-applied, pre-bedding treatment of Ridomil Gold and a foliar application of Bravo and Quadris fungicides. The pre-emergent herbicide Curbit was applied between rows before vine coverage. One fruit from each replication was measured and evaluated for soluble solids, flavor, hollowheart, average seed number per fruit, and interior color.

Results and Discussion

Overall, watermelon quality was excellent, but yields were considerably lower compared to previous years. Extreme heat at the time of second set may have reduced fruit set and yields. There were very little fungal, viral, or insect problems, but morningglory became a problem later in the season. The low seed germination rates were probably accentuated by excess moisture following seeding.

Seedless Watermelons

Triple Prize was one of the best performing seedless varieties in this trial. Revolution, Freedom, HSR 2908, Cooperstown, and Tri-X Shadow also had excellent quality (Tables 1 and 2).

Table 1. Seeded and seedless watermelon variety trial yield and fruit characteristics, Lexington, Kentucky, 2002.

										Outside Measurements	
Cultivar	**Seed Source**	**Germ. Rate (%)**	**Melon Type[1]**	**Melon Shape**	**Days to Harvest**	**Yield (cwt/A)[2]**	**Avg. No. Mkt. Fruit/ A**	**Avg. Wt/Fruit (lb)**	**No. Fruit/A <10 lb**	**Length (in.)**	**Width (in.)**
Sangria	RG	88	S	elongate	85	833.1 a	4300	19.5	0	17.6	8.3
Trillion	RU	94	T	round	90	828.3 ab	6100	13.5	0	10.4	8.4
Royalty	RU	90	S	elongate	85	807.6 abc	4000	20.0	91	15.0	9.4
Millionaire	HM	65	T	round	92	805.6 abc	5800	14.0	91	11.3	9.2
Stars N' Stripes	SI	100	S	elongate	85	788.6 abc	4500	17.6	0	18.3	8.8
Summer Flavor 800	AC	47	S	elongate	85	763.0 abc	3800	20.3	0	16.5	9.5
Triple Prize	RU	85	T	round	82	756.3 abc	5400	13.9	0	10.5	9.6
Emperor	RU	96	S	elongate	82	725.3 abcd	3500	21.0	45	15.3	10.2
Super Seedless 7167	AC	44	T	oval	85	723.7 abcd	5400	13.4	0	11.5	9.2
Treasure Chest	RU	38	T, Y	round	80	711.7 abcd	6200	11.4	0	8.5	9.1
Delta	RU	91	S	elongate	82	696.7 abcd	3200	22.0	0	14.2	9.8
US 3281	US	60	T, O	round	85	694.2 abcd	4900	14.0	45	10.6	10.4
Summer Gold	SW	100	S, G	elongate	83	690.4 abcd	2700	25.8	0	15.3	10.1
Revolution	ST	69	T	elongate	85	683.8 abcd	4400	15.5	45	13.7	9.2
AU Golden Producer	RU	80	S, G	round	90	674.5 abcd	2800	24.0	0	12.3	11.2
Freedom	ST	40	T	elongate	85-90	659.7 abcd	4200	15.6	0	13.2	9.1
HSR 2908	HL	39	T	round	87	657.9 abcd	4700	14.0	91	9.7	9.4
Cooperstown	RU	16	T	round	85	657.0 abcd	4600	14.3	0	10.8	9.6
Imperial	RU	88	S	oval	85	650.5 abcd	4200	15.4	0	12.3	6.6
Tri-X-Shadow	SW	51	T	round	89	644.3 abcd	5200	12.3	0	10.8	8.7
HMX 8914	HM	33	T	round	85	634.9 abcd	4100	15.4	0	10.7	10.2
Ultra Cool	SI	12	T	round	75	630.4 abcd	4700	13.4	45	10.0	9.6
Amarillo	ST/RU	38	T, Y	round	80	590.1 abcd	5400	10.9	182	10.0	9.6
Talladega	SI	14	T	round	83	586.3 bcd	4300	13.6	45	10.8	9.2
HSR 2914	HL	25	T	round	85	582.3 cd	4700	12.5	0	10.9	9.3
Sugarheart	SI	47	T	round	85	508.2 de	3800	13.5	0	11.1	9.4
Golden Crown Hyb.	JU	88	S	oval	78	307.2 e	4700	6.5	227	9.5	7.1

[1] Melon type: S = Seeded, T = Triploid (seedless); all varieties had red flesh color unless otherwise noted as: G = gold, O = Orange, Y = yellow.
[2] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05). Yield is based on all melons >10 lb in hundred lb (cwt) per acre.

Table 2. Seeded and seedless watermelon variety trial fruit characteristics, Lexington, Kentucky, 2002

Variety	Soluble Solids (%)	Flavor (1-5)[1]	Hollow Heart (1-2)[2]	Rind Thick. (in.)	Avg. Seed No./Fruit[3]	Interior Color[4]	Rind Type[5]	Comments
Sangria	11.5	4.5	1.8	0.7	na	red	AS	Consistent high quality, some tapered at one end.
Trillion	10.4	3.4	2.0	0.6	5.3	pk	CS	Seeds are very tiny.
Royalty	11.3	4.4	2.0	0.7	na	pk red	RS	Thin rind, some fibers in the flesh.
Millionaire	10.4	3.3	2.0	0.7	24.3	pk red	CS	Seeds are very tiny.
Stars N' Stripes	10.6	4.7	1.8	0.7	na	pk red	CS	Attractive exterior and interior, flesh is medium firm with good flavor.
Summer Flavor 800	12.0	4.2	1.5	0.7	na	red	RS	Attractive exterior and interior, nice flavor.
Triple Prize	10.6	4.0	1.8	0.9	4.3	red	dk CS	Nice flavor.
Emperor	11.0	4.1	1.8	0.7	na	pk red	CS	Large melon.
Super Seedless 7167	10.6	3.7	2.0	0.7	17.8	pk red	RS	Ground spot dark yellow when ripe, attractive red interior.
Treasure Chest	9.6	3.6	1.8	0.7	1.3	br yl	CS	Tough rind, very attractive, some dark seed traces.
Delta	11.7	4.2	2.0	0.6	na	red	CS	Attractive exterior and interior, thin rind, nice red interior.
US 3281	10.7	3.9	1.3	0.9	4.3	orange	CS	Very attractive, light seed traces, good color, hollowheart, fibers in fruit.
Summer Gold	11.1	4.4	1.3	0.7	na	gld	RS	Attractive interior and exterior, very large melon, pleasant, sweet flavor.
Revolution	10.9	4.3	2.0	0.7	2.8	br red	RS	Attractive dark green rind, firm flesh.
AU Golden Producer	11.3	4.4	1.8	0.7	na	gld	RS	Attractive interior and exterior, very large melon, thin rind at blossom end.
Freedom	11.3	4.6	1.8	0.7	3.8	red	dk JU	Attractive melon, attractive interior.
HSR 2908	11.6	4.5	2.0	0.7	2.3	pk	dk JU	Attractive dark green, tough rind, firm flesh, excellent flavor.
Cooperstown	10.9	4.5	2.0	0.6	5.3	red	CS	Rind stripes are speckled and fragmented, excellent bright red interior.
Imperial	10.3	4.1	2.0	0.5	na	br red	RS	Attractive exterior and interior color.
Tri-X-Shadow	10.4	4.6	1.5	0.6	0	pk red	BK	Attractive exterior and interior, excellent flavor.
HMX 8914	10.9	4.4	2.0	0.7	5.7	pk red	CS	Attractive exterior and interior, pleasant flavor.
Ultra Cool	10.6	3.7	1.7	0.7	0.7	pk red	RS	
Amarillo	10.0	3.5	1.5	0.7	3.3	br yl	JU	Attractive exterior and interior, seeds are gray.
Talladega	10.3	4.0	1.8	0.7	1.8	pk red	CS	Nice red interior.
HSR 2914	11.6	4.2	2.0	0.6	1.8	pk red	dk JU	Very attractive exterior and interior, firm flesh, excellent flavor.
Sugarheart	10.4	3.9	2.0	0.7	0.5	dk pk	CS	
Golden Crown Hyb.	9.3	3.2	1.8	0.3	na	dk red	yellow	Very thin, fragile rind splits easily, ripens before tendril dies.

1 Taste rating: 1 = poor, 5 = excellent.
2 Hollowheart rating: 1 = hollowheart, 2 = no hollowheart.
3 na: not applicable, seeds were not counted in the seeded varieties.
4 Flesh color: lt = light, dk = dark, pk = pink, br = bright, yl = yellow, gld = gold.
5 Rind type: AS = Allsweet, medium green rind w/dark green, broad mottles stripes; JU = Jubilee, light green rind w/distant, narrow, dark green stripes; BK = Black, solid dark green rind; CS = Crimson Sweet, light green rind w/mottled, dark green stripes; RS = Royal Sweet, light green rind w/wide, mottled, dark green stripes, dk = dark.

HSR 2908 has a very attractive, dark, Jubilee-type rind. Trillion had a very high yield, but its flavor was not as good as we would like. Millionaire and Super Seedless 7167 had unacceptable seed numbers. Treasure Chest was the best seedless yellow watermelon. US 3281, the only orange-fleshed seedless watermelon, was very good. However, it had a fair amount of hollowheart. This could have been accentuated by the high level of nitrogen fertilizer used in this study.

Seeded Watermelons

Sangria, Royalty, and Stars N' Stripes were all excellent seeded, red-fleshed watermelons (Tables 1 and 2). Summer Gold and AU Golden Producer were both large, excellent quality, golden-fleshed seeded watermelons; however, Summer Gold had more hollowheart than we would like to see.

Acknowledgments

The authors would like to thank Larry Blanford, Barry Duncil, Justin Clark, Stephanie Goode, Courtney Bobrowski, Witoon (Toon) Jaiphong, Sopon (Toni) Issaravut, Takanobu (Bell) Suzuki, Darren Taylor, Eric Bowman, and Spencer Helsabeck for their help with this trial.

Squash Bug Control and Impact on Cucurbit Yellow Vine Decline in Acorn Squash

Ric Bessin, William Nesmith, and Brent Rowell, Departments of Entomology, Plant Pathology, and Horticulture

Introduction

Squash bug can cause serious losses in summer squash, winter squash, and pumpkins in Kentucky. While all of the melon and squash crops can be attacked, the insect shows a preference for squashes and pumpkins. Squash bugs can be very difficult to control when populations are allowed to build during the summer. The insects damage plants by removing sap and causing leaves to wilt and collapse. Young plants and infested leaves on older plants may be killed directly by this pest. Typically, squash bugs begin to colonize fields about the time the vines begin to run. They remove plant sap with their piercing-sucking mouthparts. Soon after beginning to feed, they start laying eggs, primarily on the undersides of leaves in the angles between veins. The bronze eggs are football-shaped and lie on their sides in groups of 12 or more. Eggs hatch in one to two weeks. Young nymphs are green with black legs, while older nymphs are light gray.

During the past decade, a disease causing yellowing and sudden decline of cucurbit vines has been recognized mainly in the south-central states. The disease is called Cucurbit Yellow Vine Decline (CYVD). CYVD was first reported from Texas and Oklahoma, but other states in the South and Midwest also reported it after diagnostic protocols were established. Recently, CYVD was confirmed from several locations in Kentucky on squash, pumpkin, watermelon, and muskmelon. It is important to appreciate that this is a newly diagnosed disease in Kentucky, rather than a new disease. Thanks to persistent researchers from the USDA-ARS in Oklahoma, Texas A&M, and Oklahoma State University, the techniques became available late last summer to satisfy the rules of proof necessary to make a definitive diagnosis. We used their techniques in making the diagnosis in our laboratories, plus had confirmation from the laboratory of Dr. Benny Bruton, USDA-ARS, Lane, Oklahoma. It is now known that the causal agent is a phloem-limited bacterium, *Serratia marcescens*. It appears to survive in, and is transmitted to, cucurbits by the squash bug.

Symptoms of CYVD are variable, depending on plant species involved, age of plant at the time of infection, and other factors. Symptoms include the following: some plants show considerable stunting and yellowing (probably those infected early), while young fast-growing plants (that probably become infected later) may suddenly collapse without yellowing. Other plants (apparently infected later) develop striking yellow vines and decline slowly as fruits approach maturity. In watermelon, we noticed that the terminals of runners tend to become more vertical (stand up) with rolled leaves. To diagnose the disease, select plants with the above symptoms, and make cross-sectional cuts into the phloem tissues in the primary root and crown, looking for the development of a distinct golden to honey-brown discoloration of the phloem. The roots and lower stems of such plants are quickly colonized by a number of microbes that help finish the kill, and these secondary invaders will complicate diagnostic efforts. The phloem tissues in a cross-sectional cut in the lower stem appear just inside the outer layer of the stem as a series of arcs, wedges, or continuous zones (depending on age of tissue) that cap the xylem (the woody tissue with the large pores). Healthy phloem should be translucent to green, rather than yellow to browning.

Materials and Methods

A study was conducted at the UK Horticultural Research Farm in Lexington during the summer of 2002 to evaluate the effectiveness of three control methods for squash bug on acorn squash and the impact of that control on the incidence of cucurbit yellow vine decline. Four-week-old Table Gold acorn squash plants were transplanted on June 11 into raised beds with black plastic and trickle irrigation. The Table Gold cultivar was selected as it had a high level of yellow vine decline in a variety trial in 2001. Plants were spaced 18 inches apart in single rows; beds were 6 ft from center to center. Each experimental plot consisted of four rows of 15 squash plants each. Between each plot, a 30-ft-wide band of Jackpot sweet corn was transplanted into the rows to reduce squash bug and cucumber beetle movement between plots.

The commercially available squash bug treatments examined were Pounce 3.2 EC applied as a foliar spray at a rate of 6 fl oz/application, Admire 2F applied as a post-transplant drench at 20 fl oz/acre, and Platinum 2 SC applied as a post-transplant drench at 6.5 fl oz/acre. The study also included an untreated control plot. The Pounce 3.2 EC sprays were applied on June 11 and 21. The Admire and Platinum treatments were applied directly to the soil at the base of the plants in 1/3 oz of water on June 11, immediately after transplanting. The post-transplant drench was selected to minimize worker exposure to insecticide residues while trying to maximize rapid uptake of the insecticide for squash bug and cucumber beetle control. The Admire and Platinum were intentionally not mixed with the transplant water because this type of application is prohibited. All application methods used in this study are labeled for commercial use.

Prior to harvest, squash bug and cucumber beetle numbers were monitored periodically on five plants in each plot. Plants within the plots were examined on three dates for the occurrence of symptoms of CYVD (yellowing, wilting, and plant loss). Data were subjected to analysis of variance, and means were compared using Fisher's Protected LSD.

Table 1. Numbers of insects per five acorn squash plants.

	Cucumber Beetles			Squash Bug Adults			SB Egg Masses	
Treatment	**Jun. 21**[1]	**Jun. 27**	**Jul. 6**	**Jun. 21**	**Jun. 27**	**July 6**	**Jun. 27**	**Jul. 6**
Pounce 3.2EC	0.8 b	0.0 b	15.3 a	0.0 b	0.0 b	2.8 ab	0.0 b	0.8 b
Admire 2F	0.0 b	1.5 b	4.8 ab	0.3 b	1.5 b	4.5 ab	0.0 b	0.5 b
Platinum 2SC	0.3 b	0.8 b	4.0 b	0.0 b	0.0 b	1.8 b	0.0 b	0.8 b
Untreated	6.3 a	7.8 a	13.3 ab	6.0 a	4.5 a	7.0 a	6.0 a	13.0 a

1 Means in the same column followed by the same letter are not significantly different (LSD P < 0.05).

There was a sprayer problem with the Pounce treatments that was probably the result of herbicide contamination in the backpack sprayer used to treat the plots. This did cause some leaf burning and distortion that confounded initial yellow vine decline symptom assessment on the July 10 sampling date.

Results and Discussion

In this study, the squash bug moved into the plots quickly and was observed in the untreated plots on the first sampling date, June 21 (Table 1). Squash bugs were common in all plots by the third sampling date. Both systemic treatments and the foliar treatment significantly suppressed squash bug adults through the June sampling dates, but only Platinum continued to significantly reduce levels on July 6. Egg masses deposited by squash bugs were first detected on June 27, and all treatments reduced egg mass numbers through July 7. More striped cucumber beetles were captured in untreated plots than in any of the treated plots for all sampling periods.

On the first sampling date for symptoms of CYVD, only the Admire treatment reduced the number of plants with symptoms as compared to the untreated control (Table 2). By the second sampling date six days later, all of the treatments displayed a few plants with symptoms of the disease. However, by the final sampling period, all of the plots had similar percentages of plants with symptoms of the disease. During the July 25-30 sampling period, random plants displaying symptoms of CYVD were examined and confirmed to have *Serratia marcescens*, the causal agent of the disease. Each of the insecticide treatments significantly reduced the numbers of dead plants compared to the untreated control on each of the examination dates. By July 24, nearly 40% of the squash plants in the untreated plots were dead.

Yields, fruit per plot, and average fruit weight were significantly higher in each of the insecticide-treated plots compared with the untreated control (Table 3). However, the systemic treatments outyielded, in terms of total fruit weight and number, the two foliar applications of Pounce.

This study indicates that CYVD is a significant disease that can seriously limit squash production when not effectively controlled. As this disease is known to be vectored by the squash bug, management of the disease is dependent on squash bug management. Although neither Admire or Platinum lists squash bug on the label, both products provided significant squash bug reductions that resulted in delay of the onset of the disease and higher yields in this study. By the end of the study, all of the treatments had equal infection rates, although the delay in development of the disease in the insecticide-treated plots resulted in reduced severity.

Both Admire and Platinum are approved for soil application to squash for other insect pests. In this study, two foliar applications of Pounce also provided significant squash bug reductions, fewer diseased plants, and an increase in yield compared to the untreated control. It is to be expected that higher levels of control would result from additional foliar applications.

Table 2. Percentage of plants with yellow vine decline symptoms and numbers of dead plants.

	% Yellow Vine Decline			Number of Dead Plants		
Treatment	**July 10**[1]	**July 16**	**July 25/30**[2]	**July 11**	**July 16**	**July 24**
Pounce 3.2 EC	42.5 ab	49.6 b	70.0 a	3.0 b	4.3 b	10.0 b
Admire 2 F	34.6 b	45.8 b	69.2 a	1.3 b	1.3 b	3.0 b
Platinum 2 SC	38.3 ab	47.9 b	82.5 a	1.0 b	1.3 b	3.3 b
Untreated	68.8 a	76.7 a	88.8 a	11.3 a	12.8 a	23.8 a

1 Means in the same column followed by the same letter are not significantly different (LSD P < 0.05).
2 Yellow vine decline was rated over a 5-day period, one block each day.

Table 3. Acorn squash yields per plot, fruit number, and weight per fruit.

Treatment	**Weight of Fruit (lb)**[1]	**No. of Fruit**	**Weight per Fruit (lb)**
Pounce 3.2 EC	47.4 b	47.8 b	0.99 a
Admire 2 F	104.4 a	100.0 a	1.04 a
Platinum 2 SC	122.9 a	117.3 a	1.05 a
Untreated	21.3 c	26.0 c	0.79 b

1 Means in the same column followed by the same letter are not significantly different (LSD P < 0.05).

Biological Control of European Corn Borers in Bell Peppers

Karen Friley, Brent Rowell, and Ric Bessin, Departments of Entomology and Horticulture

Introduction

By adopting integrated pest management practices, commercial pepper growers in Kentucky have been able to reduce pesticide use and have been able to use them more effectively. Biological control is a difficult and often overlooked component of IPM programs for vegetable crops. Biological control techniques generally attempt to mimic natural controls in that they use a living "natural enemy" of the target pest in question to keep that pest in check, thereby eliminating or reducing the need for pesticides.

The European corn borer (ECB), *Ostrinia nubilalis*, is a serious pest of sweet corn and the primary pest of bell peppers in Kentucky. In Kentucky, damage to pepper crops is most prevalent during the middle to latter part of the growing season and is inflicted by second and third generation ECB larvae. After hatching, these larvae tunnel under the caps of pepper fruits, thereby rendering the larvae safe from pesticides. This makes the timing of any control treatment—whether pesticides or biological control—of great significance.

Recent studies in the northeastern United States have shown that the use of parasitic wasps from the genus *Trichogramma* has been effective against ECB larvae in sweet corn. After a successful preliminary trial in 2001, the University of Kentucky Entomology and Horticulture Departments began a joint two-year study in 2002 to determine the feasibility of inundative releases of the egg parasite *Trichogramma ostriniae* (T.o.) to control ECB in bell peppers. Researchers at Pennsylvania State University and Virginia Polytechnic Institute and State University began similar studies with *T.o.* in peppers in 2002 in collaboration with the University of Kentucky. Researchers at Cornell University, the University of Maine, and the University of Massachusetts also began further studies with *T.o.* in sweet corn in 2002.

Materials and Methods

Five locations within a 35-mile radius of Lexington, Kentucky, were chosen as release sites for this study. Peppers were grown with conventional production methods at three sites and with organic methods (certified organic) at two locations. Conventional field plots were located at the University of Kentucky Horticulture Research Farm ("South Farm," SF) and at the UK Spindletop Research Farm ("North Farm," NF), both at Lexington in Fayette County. The third conventional site was located within a commercial pepper grower's field in Scott County (SC). The two locations using organically approved production methods were at the students' CSA farm at Berea College (BC) in Madison County and at Kentucky State University's (KSU) Research and Demonstration Farm in Franklin County.

Two bacterial spot-resistant bell pepper cultivars, Aristotle and Early Sunsation, were used for these experiments. Aristotle was used at SF, SC, and BC, while Early Sunsation was used at NF and KSU (Table 1). Plants were started at the greenhouse at the South Farm where they were grown conventionally or organically, depending on final destination. Peppers for the conventional plots were sown 20 March and transplanted to 72-cell trays on 4-5 April. Peppers for the organic plots were sown on 2 April and were transplanted to 72-cell trays on 19 April. The commercial grower produced his own transplants (cv. Aristotle) at SC. Peppers were transplanted to the field on the dates shown in Table 1.

Peppers were transplanted into raised beds with black plastic and drip irrigation at SF, NF, and SC. At SF, NF, and SC, peppers were grown in two rows/bed with plants 12 inches apart in the rows and 15 to 16 inches between the double rows. Peppers were grown in single rows at BC and KSU. Beds or single rows were approximately 6 ft between centers at each location. Black plastic mulch was used at KSU, while peppers were grown on bare ground at BC (Table 1). Drip irrigation was used at all locations. Conventional plots at SF and NF received preplant applications of 50 lb N/A and supplemental "fertigated" applications totaling 40 lb N/A during the growing season. Phosphorus and potassium were applied prior to planting according to soil test results at these two locations. Organic plots at KSU received preplant applications of compost. A cover crop of white clover was plowed under prior to planting at BC. Plots at BC and KSU received supplemental liquid organic nitrogen fertilizer through the drip system (Phitamin 800, Peaceful Valley Farm Supply, Grass Valley, CA). Extensive cultivation and hoeing was required for weed control at BC, while herbicides and two cultivations were required in conventional plots. No insecticides were used in plots at any of the five locations, while fixed copper was used for bacterial spot prevention at the conventional sites.

Treatments at each location consisted of a control (no release) plot and a *T.o.* release plot. The two plots were 1,000 ft apart except for SC where that separation distance

Table 1. Test locations, cultural practices, and cultivars used in control and *Trichogramma ostriniae* release plots in Central Kentucky, 2002.

Location[1]	Transplanting Date	Growing System[2]	Cultivar	Cultural Practices[3]
SF	24 May	Conv	Aristotle	RB,DR,P
NF	5 June	Conv	Early Sunsation	RB,DR,P
SC	16 May	Conv	Aristotle	RB,DR,P
BC	29 May	Organic	Aristotle	SR,B
KSU	24 May	Organic	Early Sunsation	SR,P

1 SF = South Farm, NF = North Farm, SC = Scott County, BC = Berea College, KSU = Kentucky State University.
2 Conv = grown using conventional practices, Organic = grown under certified organic conditions.
3 RB = raised beds, DR = Double Rows, P = black plastic mulch with drip irrigation, SR = single rows, B = bare ground.

was not possible because of the limited overall size of the grower's field. Plots were only 300 ft apart at SC. Each release plot was located downwind from each control plot to reduce the possibility of *T.o.* being blown into the control plot. ECB pheromone traps (Texas cone traps) were placed adjacent to each plot to monitor timing and numbers of ECB moth flights. The traps were checked and emptied weekly, and the numbers of ECB moths recorded. Pheromone lures were replaced monthly.

Trichogramma ostriniae were purchased from IPM Laboratories Inc., Locke, New York, and sent by overnight express to arrive within a day or two of the scheduled release dates. These came in the form of parasitized *Ephistia kuehniell* eggs, which had been glued onto cards that were perforated into 1-inch square sections. The number of squares needed was calculated for each release plot, as plots were not all the same size. A total release of 450,000 *T.o.*/A was made at each location. This total was divided among three releases of 150,000 *T.o.*/A per release.

T.o. release dates were chosen in accordance with a degree-day model predicting egg laying of second-generation ECB at each location. Releases began on or near the model-predicted date for the initiation of second-generation ECB egg laying at that location. The second and third releases at each location corresponded to model-predicted 25% and 75% completion of egg laying (Table 2). Squares containing the *T.o.* were placed into cardboard "hangers" provided by IPM Laboratories. These were folded, stapled, and hung on pepper plants in the center of each release plot. The hangers protected *T.o.* from predators while allowing the parasites to exit through small spaces at the edges of the folded cardboard.

Twenty sentinel ECB egg masses, provided by the USDA lab at Iowa State University, were pinned to the undersides of pepper leaves in the border rows of both the control and release plots at the time of each release and at weekly intervals thereafter until final harvests. These were used to determine the percentage of parasitization at each location and to help determine whether *Trichogramma ostriniae* were establishing themselves. These egg masses were retrieved after 48 to 72 hours, placed into gelatin capsules, and stored in a temperature-controlled cabinet at 74°F.

Treatment plot sizes varied among locations; each plot was approximately 1,500 ft^2 (500 plants/plot in double rows) at the three conventional sites and approximately 3,000 ft^2 (500 plants/plot in single rows) at the two organic sites. All rows of each plot except the border rows were harvested to determine yields and ECB infestation levels. Correction factors were used to equalize plot sizes among all locations when yields were calculated and compared. Peppers were harvested and separated into insect-damaged and undamaged fruits and then sorted again according to USDA grades before they were counted and weighed. All fruit appearing to be insect-damaged were carefully dissected to look for ECB larvae. The number of ECB-damaged or infested fruits as well as the number of larvae found within each fruit were recorded. The number of times plots were harvested varied by location (Table 3).

Yields of individual USDA grades and total marketable yield were compared using a simple T-test (P<0.05) with the five locations used as blocks in a randomized complete block design.

Results and Discussion

The overall average percentage of fruits infested with ECB was significantly lower (1.1%) in the *T.o.* release plots than in the control plots (4.2%) when data from all locations were combined (Table 4). The same trend is obvious when the data were separated by production system (organic or conventional); there were approximately three times as many ECB-infested fruits in the control plots as in the release plots at the three conventional locations. There were approximately 10 times as many ECB-infested fruits in control plots as in release plots at the two organic sites (Table 4). However, given the limited error degrees of freedom available for comparing treatments within conventional or organic systems (df = 2 and 1, respectively), it is not surprising that these differences were not statistically significant. As might be expected given the low numbers of ECB this year at all five locations, there were no differences in marketable yields between control and release plots (Table 5).

Numbers of ECB moths captured in pheromone traps have not yet been tabulated, as all identifications had not been completed at the time of this writing. Determination of percent parasitization of ECB sentinel egg masses has also not yet been completed.

European corn borer numbers were low at these five locations in Central Kentucky throughout the 2002 growing season as indicated by trap catches. Biological control of ECB in peppers using inundative releases of *T.o.* appears promising, at least when ECB infestations are low. This was the first year of a two-year study; next year we hope to include a site from

Table 2. Release dates for *Trichogramma ostriniae* at five Central Kentucky locations, 2002.

Location[1]	System[2]	1st Release	2nd Release	3rd Release
SF	Conv	10 July	18 July	25 July
NF	Conv	10 July	18 July	25 July
SC	Conv	10 July	18 July	23 July
BC	Organic	26 June	9 July	17 July
KSU	Organic	10 July	17 July	24 July

1 SF = South Farm, NF = North Farm, SC = Scott County, BC = Berea College, KSU = Kentucky State University.
2 Conv = grown using conventional practices, Organic = grown under certified organic conditions.

Table 3. Bell pepper harvest dates at five locations in Central Kentucky, 2002.

Location[1]	1st Harvest	2nd Harvest	3rd Harvest
SF	17 July	6 Aug	22 Aug
NF	31 July	14 Aug	--
SC	23 July	29 July	4 Sept
BC	5 Aug	27 Aug	--
KSU	14 Aug	--	--

1 SF = South Farm, NF = North Farm, SC = Scott County, BC = Berea College, KSU = Kentucky State University.

northwestern Kentucky where larger ECB infestations are common in commercial pepper plantings.

Acknowledgments

The authors wish to greatly thank Darrell Slone, April Satanek, Philip Bush, and the UK Horticulture Farm summer workers for all of their hard work and wonderful assistance. Also thanks to Dr. John Snyder for analyses of the data. We would also like to thank the other institutions and individuals involved in this cooperative research, including Dr. Sean Clark at Berea College, Tony Silvernail at Kentucky State University, John Bell in Scott County, and Jeanette Dyer from the USDA lab at Iowa State University. This project is supported by a grant from the USDA's Cooperative State Research, Education, and Extension Service (CSREES).

Table 4. Average percentage of pepper fruits infested with one or more European corn borer larvae at five locations in Central Kentucky, 2002.

	Conventional Sites				Organic Sites			
Treatment	**SF[1]**	**NF**	**SC**	**All Conv.**	**BC**	**KSU**	**All Organic**	**All Sites**
				% Infested Fruit				
Control	4.7	2.2	8.0	5.0	0.8	5.1	3.0	4.2
Release	0.8	1.6	2.2	1.6	0.0	0.6	0.3	1.1
Significance	--	--	--	NS[2]	--	--	NS	*

1 SF = South Farm, NF = North Farm, SC = Scott County, BC = Berea College, KSU = Kentucky State University.
2 NS = non-significant.
* Difference statistically significant by T test at $P \leq 0.05$.

Table 5. Total marketable yields of control and release treatments for equivalent plot sizes at five locations in Central Kentucky, 2002.

	Conventional Sites				Organic Sites			
Treatment	**SF[1]**	**NF**	**SC**	**All Conv.**	**BC**	**KSU**	**All Organic**	**All Sites**
				tons/acre				
Control	13.4	14.5	5.4	11.1	3.0	5.6	4.3	8.4
Release	13.1	12.7	10.1	12.0	3.1	3.2	3.2	8.4
Significance	--	--	--	NS[2]	--	--	NS	NS

1 SF = South Farm, NF = North Farm, SC = Scott County, BC = Berea College, KSU = Kentucky State University.
2 NS = non-significant.

Effects of Actigard on Tomato Yields

Amanda Ferguson, R. Terry Jones, John Snyder and William Nesmith, Departments of Horticulture and Plant Pathology

Introduction

Kentucky growers currently produce about 1,000 acres of staked vine-ripened tomatoes for both local and national markets. Kentucky tomatoes have an excellent reputation for quality in many market areas. During the past few years bacterial diseases (bacterial spot, speck, and canker) have become major concerns for many fresh market producers. The traditional spray program used by growers offers little in the way of control for these bacterial diseases. The emergence of bacterial diseases that are resistant to copper or streptomycin has complicated traditional control of bacterial diseases on tomatoes. All of these bacterial diseases can be seed-borne, and, with increased reliance on foreign production of hybrid seeds, the number of transplants carrying one or more of these diseases has increased. A new approach to disease control (plant immunity), Actigard, recently received a label for use on tomatoes.

Actigard, a plant activator, stimulates the plant's natural defense system, inducing systemic activated resistance (SAR) in the plant. This allows the plant to defend itself against fungal, bacterial, or viral attacks. The evolution of pathogens resistant to chemicals is all but inevitable. Already, some pathogens are resistant to our conventional chemical weapons, such as copper. By choosing a chemical that stimulates the plants' natural defense system, we may begin to win the battle against the rapidly evolving pathogens. Although it has been shown that Actigard can reduce the percentage of fruit and leaves infected, adequate research has not been done on the effects of Actigard on the horticultural and morphological characteristics of the tomato plant. It is reasonable to believe that since the plant is giving more of its overall energy to activating its immune system, less energy will be available for other plant functions (growth, fruit development). This could affect the size, shape, or number of the leaves, stems, or fruits.

We need to compare various disease management strategies to determine their impact on quality and yield. This research focused on measuring the effects of Actigard use on tomato fruit yield under Kentucky conditions.

Materials and Methods

Three different tomato cultivars, Cherry Grande, Heavy Weight, and Mountain Fresh were used. Cherry Grande is a 66-day, determinate, red cherry tomato cultivar. Heavy Weight is a 78-day, indeterminate, red-fruited cultivar, and Mountain Fresh is a 77-day, determinate, red-fruited cultivar that is commonly grown in Kentucky.

Tomato transplants were started in the greenhouse on 4 April 2001 and transplanted to the field on 5 May. Based on soil test results, 50 lb/A N and 100 lb/A K_2O fertilizer were applied preplant. An additional 75 lb of N and 50 lb of K_2O were applied during 10 weekly applications through the drip irrigation lines. Tomatoes were planted in rows 7 ft apart with plants spaced 18 inches apart in the row.

Tomato plants were treated with one of two spray regimes. The traditional regime consisted of a weekly spray program using alternating applications of mancozeb and Quadris early in the growing season, followed by weekly applications of Bravo plus fixed copper late in the season. A total of 13 applications were made. Fixed copper was added to the Bravo spray program because of the appearance of bacterial spot. The Actigard regime was the same as the traditional regime, plus it included six weekly applications of Actigard starting on 25 May, 16 days after the tomatoes were transplanted. The last application was made 27 June. The first two weekly applications consisted of one-third of an ounce Actigard 50WG in 50 gallons. One-half of an ounce in 70 gallons was applied during weeks three and four, and three-fourths of an ounce Actigard 50WG in 100 gallons was used for weeks five and six.

In addition to the weekly fungicide treatment, all plots received insecticides (Endosulfan 3EC or Pounce 3.2 EC) as needed to control Colorado Potato Beetles or aphids.

Harvests began on 24 July and continued until 30 August for a total of nine or 10 harvests depending on the cultivar. Tomatoes were graded, counted, and weighed.

Results

For early yield of Cherry Grande, application of Actigard did not affect yield or fruit number (Tables 1 and 2) but did result in reduced yield (pounds and number) of jumbo/extra large and large Heavy Weight tomatoes compared to the traditionally treated controls. Interestingly, treatment with Actigard was associated with a reduction in pounds of Heavy Weight cull fruit. Early yields of jumbo/extra large Mountain Fresh fruit were also reduced in the Actigard treatment. Total early yields (Tables 1 and 2) were less when Actigard was applied to the Heavy Weight and the Mountain Fresh cultivars, compared to their traditionally treated controls. However, total yield of Cherry Grande was unaffected by Actigard application. Yields of medium and No. 2 fruit were unaffected by treatment with Actigard regardless of tomato cultivar. Differences in early yield between traditional treatment and the Actigard treatment were mainly related to differences in the size and number of large or extra large/jumbo fruit.

Trends for total season yields (pounds and fruit number) were very different from those for early yield (Tables 3 and 4). Cherry Grande had a significant reduction in medium and small fruit numbers and pounds of medium/small tomatoes and a reduction in cull fruit numbers when Actigard was used, compared to the traditionally treated control. Application of Actigard on Heavy Weight tomato was associated with a severe reduction in pounds of large fruit and number of large and extra large/jumbo fruit, compared to its traditionally treated control. Pounds and number of cull fruit were reduced when Actigard was used on Heavy Weight. For Mountain Fresh total season yields, application of Actigard resulted in an increase in the pounds and number of extra large/jumbo tomatoes and a reduction in the pounds of cull tomato fruit.

There was an interaction between tomato cultivar and the spray treatment used. Compared to its traditionally treated control, Mountain Fresh treated with Actigard had a lower yield early in the season, but season-long total

Table 1. Early yield in each grade category of three tomato cultivars, treated or not treated with Actigard, Quicksand, 2001.

Cultivar	Treatment[1]	No. 1 Jumbo + Extra Large[2]	No. 1 Large[2]	No. 1 Med + Small[2]	No. 2[2]	Culls[2]	Total
				Pounds/A			
Cherry Grande	T	-	9,231 ns	8,880 ns	3,799 ns	1,997 ns	23,906 ns
	T & A	-	9,827	7,869	3,630	1,854	23,180
Heavy Weight	T	12,990*	13,185*	9,373 ns	920 ns	5,315**	41,784*
	T & A	6,887	8,167	8,142	2,048	3,539	28,781
Mt. Fresh	T	19,343*	2,009 ns	363 ns	1,296 ns	1,245 ns	24,256*
	T & A	15,132	1,063	207	700	882	17,981

1 T = Traditional spray regime, T&A = Traditional spray regime plus Actigard; see Materials and Methods.
2 Jumbo fruit > = 3.5 in., Extra Large > = 2.75 but < 3.5 in., Large > = 2.5 but < 2.75, Medium < 2.5 in.
The ns, *, and ** indicate a non-significant difference between the pair of means for a cultivar, a difference at P = 0.05 and 0.01, respectively. The means are least square means, compared by t-test. Preplanned comparisons were used.

Table 2. Number of fruit per acre in each grade category for the early harvests of three cultivars of tomato treated with Actigard or not treated, Quicksand, 2001.

Cultivar	Treatment[1]	No. 1 Jumbo + Extra Large[2]	No. 1 Large[2]	No. 1 Med + Small[2]	No. 2[2]	Culls	Total
				Number of Fruit/A			
Cherry Grande	T	0	38,763 ns	49,523 ns	21,910 ns	17,243 ns	127,439 ns
	T & A	0	42,782	40,449	19,187	14,779	117,197
Heavy Weight	T	30,985*	40,838*	43,041 ns	2,334 ns	21,650 ns	138,847*
	T & A	15,816	27,484	37,856	7,390	16,465	105,011
Mt. Fresh	T	32,540*	5,964 ns	1,426 ns	2,593 ns	3,371 ns	45,893 ns
	T & A	26,577	2,852	778	1,296	1,815	33,318

1 T = Traditional spray regime, T&A = Traditional spray regime plus Actigard; see Materials and Methods.
2 Jumbo fruit > = 3.5 in., Extra Large > = 2.75 but < 3.5 in., Large > = 2.5 but < 2.75, Medium < 2.5 in.
The ns, *, and ** indicate a non-significant difference between the pair of means for a cultivar, a difference at P = 0.05 and 0.01, respectively. The means are least square means, compared by t-test. Preplanned comparisons were used.

Table 3. Total yield in each grade category of three tomato cultivars, treated or not treated with Actigard, Quicksand, 2001.

Cultivar	Treatment[1]	No. 1 Jumbo + Extra Large[2]	No. 1 Large[2]	No. 1 Med + Small[2]	No. 2[2]	Culls	Total
				Pounds/A			
Cherry Grande	T	0	23,362 ns	36,663**	4,615 ns	4,836 ns	69,476 ns
	T & A	0	25,695	33,098	4,719	3,656	67,167
Heavy Weight	T	21,521 ns	24,191*	28,353 ns	2,502 ns	9,542*	86,108*
	T & A	13,509	16,581	25,890	3,850	6,651	66,481
Mt. Fresh	T	59,428**	10,644 ns	2,437 ns	2,865 ns	3,228**	78,602 ns
	T & A	70,655	10,735	3,150	1,727	1,516	87,781

1 T = Traditional spray regime, T&A = Traditional spray regime plus Actigard; see Materials and Methods.
2 Jumbo fruit > = 3.5 in., Extra Large > = 2.75 but < 3.5 in., Large > = 2.5 but < 2.75, Medium < 2.5 in.
The ns, *, and ** indicate a non-significant difference between the pair of means for a cultivar, a difference at P = 0.05 and 0.01 respectively. The means are least square means, compared by t-test. Preplanned comparisons were used.

Table 4. Number of fruit per acre in each grade category for entire season of three cultivars of tomato treated with Actigard or not treated, Quicksand, 2001.

Cultivar	Treatment[1]	No. 1 Jumbo + Extra Large[2]	No. 1 Large[2]	No. 1 Med + Small[2]	No. 2[2]	Culls	Total
				Number of Fruit/A			
Cherry Grande	T	0	105,400 ns	228,171*	27,873 ns	56,395*	417,839 ns
	T & A	0	116,419	198,613	27,613	37,078	379,724
Heavy Weight	T	51,875**	79,341**	146,756 ns	8,297 ns	51,728**	337,979**
	T & A	31,244	55,876	131,717	14,260	42,134	275,232
Mt. Fresh	T	106,955*	33,707 ns	12,057 ns	7,260 ns	12,316 ns	172,295 ns
	T & A	136,644	33,448	14,261	4,667	4,667	193,686

1 T = Traditional spray regime, T&A = Traditional spray regime plus Actigard; see Materials and Methods.
2 Jumbo fruit > = 3.5 in., Extra Large > = 2.75 but < 3.5 in., Large > = 2.5 but < 2.75, Medium < 2.5 in.
The ns, *, and ** indicate a non-significant difference between the pair of means for a cultivar, a difference at P = 0.05 and 0.01 respectively. The means are least square means, compared by t-test. Preplanned comparisons were used.

yield for the Actigard treatment was greater than its control. On the other hand, both early and total yield of Heavy Weight was reduced by application of Actigard. Cherry Grande early-season yields were not affected by the spray program, but for the full season, number and pounds of medium/small fruit and culls were reduced by Actigard application. In general, the application of Actigard reduced the number and pounds of cull fruit. This reduction was not associated with any obvious fruit disease. A late-season infection of bacterial leaf spot developed in the trial during harvest.

There was a significant difference between the three tomato cultivars in disease severity (Table 5). Mountain Fresh had less disease than the other two cultivars. Cherry Grande had significantly more. At the time of the first evaluation, the Mountain Fresh plants that had been treated with Actigard had significantly less disease than the traditionally treated Mountain Fresh plants (Table 6). Two weeks later, this difference had disappeared. The final traditional spray was applied to the tomatoes on 2 August. Actigard's effects on tomato fruit yield occurred prior to the development of the bacterial disease.

Additional studies are needed: 1) to determine the effects of Actigard on the majority of tomato cultivars grown in Kentucky; 2) to determine the best timing of Actigard sprays; and 3) to determine the effects of location and time of year on Actigard application. There is no doubt that the use of Actigard can significantly reduce potential yield losses due to bacterial spot/speck epidemics. However, this protection may have a price associated with it. We recom-

Table 5. Bacterial speck disease ratings on 31 August and 14 September for three tomato cultivars. Means are averages for tomato plants treated and not treated with Actigard.

Cultivar	Bacterial Speck Rating[1] 31 August	14 September
Mt. Fresh	1.8c	2.1b
Heavy Weight	2.6b	2.1b
Cherry Grande	3.5a	4.4a

1 Bacterial speck was rated on 8/31/01 by T. Jones using a 0-5 scale: 0 = no speck, 5 = near total leaf coverage with spot. W. Nesmith rated on 9/14/01 using the same subjective scale. Means followed by the same letter are not significantly different, LSD (P = 0.05). The ratings were made 65 and 79 days after the last application of Actigard on June 27.

Table 6. Bacterial speck disease ratings for three varieties of tomato treated with Actigard or not treated.

Variety	Treatement[2]	Bacterial Speck Rating[1] 31 August	14 September
Mt. Fresh	T	2.5bc	2.125b
	T&A	1.0d	2.0b
Heavyweight	T	3.0abc	2.125b
	T&A	2.25c	1.875b
Cherry Grande	T	3.75a	4.375a
	T&A	3.25ab	4.5a

1 Bacterial speck was rated on 31August by T. Jones using a 0-5 scale: 0 = no speck, 5 = near total leaf coverage with spot. W. Nesmith rated on 14 September using the same subjective scale. The ratings were made 65 and 79 days after the last application of Actigard on June 27. Means within a column followed by the same letter are not significantly different, LSD (P = 0.05).
2 T = Traditional spray regime, T&A = Traditional spray regime plus Actigard; see Materials and Methods.

mend that growers practice sanitation and follow a recommended spray program in tomato transplant production. Tomato fields should be properly fertilized and rotated to reduce disease problems. Actigard, if used, should probably be applied biweekly, separate from other pest control applications. Thorough coverage with Actigard is not necessary, so spray volume/acre could be reduced.

Cover Crop Roll-Down for Weed Suppression in No-Till Crop Production

Sean Clark and Michael Panciera, Department of Agriculture and Natural Resources, Berea College

Introduction

No-till crop production has a number of advantages over conventional tillage, including improved soil moisture retention, reduced soil erosion, lower energy use, and reduced losses of soil organic matter. However, no-till agriculture as it is generally practiced, is dependent on herbicide use, which can lead to other problems, including groundwater and surface water contamination and risks to human health. Developing no-till methods that are not herbicide dependent will lead to cropping systems that not only protect soil resources but do so without the environmental and human health costs often associated with herbicide use.

Over the past decade, researchers and farmers in several states have been evaluating and improving cover crop management practices in no-till horticultural cropping systems (Teasdale and Abdul-Baki 1998, Morse 1999, Creamer and Dabney 2002, Abdul-Baki et al. 2002). Rolling down a mature winter cover crop in the spring and planting or transplanting directly into the mulch residue that is left on the surface has proven feasible and provides a variety of benefits. By rolling the cover crop down rather than mowing it, the cover crop residue breaks down more slowly, providing longer weed suppression by the mulch.

While cover crop roll-down has significant potential to make no-till farming less herbicide dependent and more profitable, there are several potential problems that need addressing. First, there is the possibility of cover crop regrowth after roll down that can result in serious, yield-limiting competition with the planted crop. Research and experience has shown that the timing of the roll-down relative to the maturity of the small grain and/or legume cover crop is critical for avoiding cover crop re-growth problems. In addition, the cover crop residue may not last long enough to provide sufficient weed control. Additional weed management practices may be needed, such as herbicide applications, cultivations, or flaming.

Materials and Methods

A field experiment was conducted at the educational farm of Berea College *www.berea.edu/ANR/farms.htm* to evaluate cover crop roll-down for field corn production. The experiment included three treatments with four replications. The treatments included:

1. Cover crop roll-down only (no herbicides).
2. Cover crop roll-down followed by an application of glyphosate (Roundup, 1 qt/A) at corn planting.
3. Cover crop roll-down followed by an application of glyphosate (Roundup, 1 qt/A) at corn planting and an application of dicamba (Banvel, 0.5 pt/A)* and primisulfuron-methyl (Beacon, 0.76 pt/A)* one month after planting.

Rye Winter King was planted as a winter cover crop in the entire field site on October 15, 2001, at 100 lb/A. On May 17, 2002, the rye was rolled down with a rolling stalk chopper when it reached the "soft dough" stage (Figure 1). At this time the total aboveground biomass of the rye was 2.4 T/A. Plots were established, each measuring 12.7 ft wide and 500 ft long (6,350 ft^2), in a randomized block design.

On May 22, corn Pioneer 33Y18 was planted at 19,600 seeds/A using a John Deere series 7000, four-row planter modified for high residues (fluted coulter, residue cleaners in front of unit, and spiked closing wheels) in 38-inch rows (Figure 2). Glyphosate was applied in a 12-inch band over the rows at planting in treatments 2 and 3 to suppress weeds and possible rye re-growth. On June 19, dicamba (Banvel, 0.5 pt/A) and primisulfuron-methyl (Beacon, 0.76 pt/A) were applied to treatment 3. Fertilizer (150 lb/A of N as urea and 45 lb/A of K as KCl) was applied to all plots on June 26.

Corn plant stand counts were made after planting to ensure equal stands in the three treatments. Corn and weed biomass were measured by field sampling when the corn reached the silking stage (July 22) to assess the effects of the herbicide treatments. At maturity, the corn was hand harvested to estimate grain yield (October 8). Net economic returns were calculated by subtracting total costs from gross returns (yields multiplied by price per bushel).

Results and Discussion

Corn plant populations were the same in all three treatments, approximately 20,000 plants per acre. Corn plant biomass at silking was significantly greater and weed biomass significantly lower in treatment 3, which received the two herbicide applications, compared to the other two treatments (Table 1). Treatments 1 and 2, however, did not differ from each other in corn or weed biomass at this time, indicating that the glyphosate application was not

For field corn only; neither Banvel nor Beacon are labeled for use on sweet corn.

Figure 1. Rolling down the rye cover crop using a rolling stalk chopper before corn planting, Berea, KY, 2002.

Figure 2. The no-till corn planter was modified for high surface residues: fluted coulter, residue cleaners in front of seeding unit, and spiked closing wheels, Berea, KY, 2002.

necessary for weed or cover crop suppression. There was little cover crop re-growth, and rye mulch effectively suppressed weeds early in the corn season.

At maturity, no significant differences in corn grain yield were found among the three treatments, but treatment 3, which received the two herbicide applications, had the highest overall yield (Table 2). Treatment 1, which received no herbicide applications, had the greatest variability in yield across the replicates, but average grain yield in this treatment was approximately the same as that of treatment 2, which received glyphosate (Table 2).

All three treatments were profitable at corn prices ranging from \$2.00 to \$2.50 per bushel. The application of glyphosate at planting did not improve profitability, but the post-emergence herbicide application did improve profits slightly. Based on these findings, it appears a cover crop of rye rolled down before planting can provide effective weed control even without herbicide applications. In this study, the herbicide application one month after planting did contribute to slightly higher yields but did not improve profitability dramatically.

In conclusion, rolling down a winter cover crop of rye can provide very good weed suppression in no-till crop production systems, reducing or eliminating the need for herbicides. Although cover crops that are used as mulch will add to the costs of production, they may still increase profitability by suppressing weeds, reducing herbicide costs, and conserving soil moisture for the cash crop. Future studies will evaluate rye seeded at higher rates (e.g., 150 lb/A) to achieve greater biomass at roll-down for season-long weed suppression. In addition, the cover crop roll-down system will be evaluated for other crops including sweet corn, squash, pumpkins, and tomatoes. By incorporating hairy vetch into a mixture with rye, N fertilizer needs may be reduced as well.

Table 1. Average corn and weed above ground biomass (lb/A) at corn silking in the cover crop roll-down experiment, Berea, Kentucky, July 22, 2002.

	Biomass (lb/A)		
Treatment	**Corn**	**Weed**	**Total**
1	4275 a*	2285 a	6560
2	4734 a	1871 a	6605
3	5505 b	868 b	6373

* Means within columns with different letters are significantly different (Tukey test, P 0.05).

Table 2. Average corn grain yield, cost of production, gross returns, and net returns for the three treatments in the cover crop roll-down experiment, Berea, Kentucky, October 8, 2002.

	Treatment		
	1	**2**	**3**
Corn grain yield (bu/A)	127	121	144
Total cost of production (\$/A)	200	204	232
Gross returns at \$2.00/A (\$/A)	254	242	288
Net returns at \$2.00/A (\$/A)	54	38	56
Gross returns at \$2.50/A (\$/A)	318	303	360
Net returns at \$2.50/A (\$/A)	118	99	128

Acknowledgments

Bob Harned, Justin Ranck, Jason Hughes, Amanda Richie, Faye Tewksbury, Wendell Garnett, Anna Armstrong, Beth Perkins, Denis Burton, and Casey Babb contributed in various ways to this field study, including planting and data collection.

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Fruit and Vegetable Disease Observations from the Plant Disease Diagnostic Laboratory

Julie Beale, Paul Bachi, William Nesmith, and John Hartman, Department of Plant Pathology

Introduction

Diagnosis of plant diseases and providing recommendations for their control are the result of UK College of Agriculture research (Agricultural Experiment Station) and Cooperative Extension Service activities through the Department of Plant Pathology. We maintain two branches of the Plant Disease Diagnostic Laboratory, one on the UK campus in Lexington, and one at the UK Research and Education Center in Princeton. Of the more than 4,000 plant specimens examined annually, approximately 10% to 15% are commercial fruit and vegetable plant specimens (1). The annual number of commercial fruit and vegetable specimens diagnosed has more than doubled in recent years, but, because of their complexity and diversity, the time needed to diagnose them has more than doubled. Although there is no charge to the growers for plant disease diagnosis at UK, the estimated direct annual expenditure to support diagnosis of fruit and vegetable specimens by the laboratory is $25,000, excluding UK physical plant overhead costs.

Materials and Methods

Diagnosing fruit and vegetable diseases involves a great deal of research into the possible causes of the problem. Most visual diagnoses include microscopy to determine what plant parts are affected and to identify the microbe involved. In addition, many specimens require special tests such as moist chamber incubation, culturing, enzyme-linked immunosorbent assay (ELISA), electron microscopy, nematode extraction, or soil pH and soluble salts tests. Diagnoses which require consultation with UK faculty plant pathologists and horticulturists, and which need culturing and ELISA, are common for commercial fruits and vegetables. The laboratory also has a role in monitoring pathogen resistance to fungicides and bactericides. These exceptional measures are efforts well-spent because fruits and vegetables are high-value crops for Kentucky. Computer-based laboratory records are maintained to provide information used for conducting plant disease surveys, identifying new disease outbreaks, and formulating educational programs.

The 2002 season had an unusually warm fall (2001) and mild winter. January temperatures were 7° to 10°F above normal and reached 60° to 70°F, causing some buds to swell. On March 4, temperatures dropped into the single digits (4° to 6°F), and on March 22 temperatures dropped into the mid-teens. Many peach buds and the king bloom on some apple varieties were lost in a number of orchards. On May 19, a particularly late freeze occurred that killed more peach and apple blooms. The late freeze was particularly hard on grapes in low-lying areas, which had made extensive growth by this time. Extremely warm temperatures in April favored severe fire blight in the central and eastern portions of the state.

Statewide, wet weather generally prevailed in March, April, and May, but dry weather was prevalent during June, July, and August. Rain was spotty, and some locales suffered severe drought, while others suffered only moderate drought. One grower in the Owensboro area reported 120 days without rain. Summer temperatures were above normal in addition to being dry.

Results and Discussion

New and Emerging Fruit and Vegetable Diseases in Kentucky

- Pierce's disease of grapes caused by *Xylella fastidiosa.*
- Grape crown gall caused by *Agrobacterium tumefaciens* emerges with more grapes grown.
- Cucurbit yellow vine decline caused by *Serratia marsescens.*
- Root, stem, and fruit diseases of solanaceous and cucurbit vegetables caused by *Phytophthora* spp.
- Bacterial canker of peppers caused by *Clavibacter michiganensis* subsp. *michiganensis.*
- Copper-resistant bacterial speck of tomatoes caused by *Pseudomonas syringae* pv. *tomato.*

Tree Fruit Diseases

Rain and long periods of spring leaf wetness increased the occurrence of primary infections of apple scab (*Venturia inaequalis*) and cedar rust (*Gymnosporangium juniperi-virginianae, G. clavipes,* and *G. globosum*). Periodically mild spring weather and showers during apple and pear bloom resulted in significant fire blight (*Erwinia amylovora*) in those areas of the state where bloom, warm weather, and rain coincided. Some Asian pears were hard hit. Spring frosts occurred and may have exacerbated fire blight. Spring rains also favored apple frogeye leaf spot (*Sphaeropsis malorum*). Dry summer weather reduced incidence of secondary apple scab and apple sooty blotch (*Peltaster fructicola, Geastrumia polystigmatis, Leptodontium elatius*, and other fungi) and flyspeck (*Zygophiala jamaicensis*), all of which are enhanced by long leaf wetness periods. Bitter rot (*Colletotrichum gloeosporioides*) was found in some apple orchards. Apple southern blight (*Sclerotium rolfsii*) was found in a newly planted orchard.

Winter and spring freezes resulted in some tree fruit injury that could have exacerbated stone fruit Cytospora (*Leucostoma persoonii*) cankers. As leaves emerged, peach leaf curl disease (*Taphrina deformans*) appeared. Spring rains favored peach scab (*Cladosporium carpophilum*) bacterial canker (*Pseudomonas mors-prunorum*), bacterial leaf spot (*Xanthomonas campestris* pv. *pruni*), and brown rot (*Monilinia fructicola*).

Small Fruit Diseases

Greenhouse strawberries were subject to powdery mildew (*Sphaerotheca macularis* f.sp. *fragarae*), and in the field strawberry leaf spot (*Mycosphaerella fragariae*) was common. In brambles, systemic orange rust (*Gymnoconia nitens*) and blackberry rosette (*Cercosporella rubi*) were frequently observed. Grape crown gall (*Agrobacterium tumefaciens*) continues to be a very serious problem for growers. Wet spring weather favored black rot (*Guignardia bidwellii*) and anthracnose (*Elsinoe ampelina*). Several cases of grape downy mildew (*Plasmopara viticola*) were observed. Pierce's disease (*Xylella fastidiosa*) in western Kentucky was confirmed. Summer air stagnation caused ozone injury to many plants and was especially noticeable on grapes.

Vegetable Diseases

In accord with a wet spring and hot, dry summer in many areas of the state, infectious diseases played a significant role in successful production of commercial vegetable crops.

Vegetable Transplants. Several diseases were diagnosed from vegetable transplant production within the state, including: Pythium root rot (*Pythium* sp.) of tomato, pepper, broccoli, and cantaloupe seedlings and transplants. Pythium root rot was diagnosed mainly from transplant operations involving the float system. Pepper transplants with gray mold blight (*Botrytis cinerea*) were also observed.

Cole Crops. Bacterial soft rot (*Erwinia carotovora*) was observed on cabbage. This disease sometimes follows infection by black rot (*Xanthomonas campestris*) bacteria. Another disease diagnosed included wirestem (*Rhizoctonia solani*) on transplants and newly set cole crops, including cabbage, and cauliflower, plus the fungus caused stem and head rots later in the season.

Tomatoes. Commercial tomato plantings were infected by several bacterial diseases including bacterial canker (*Clavibacter michiganensis*), bacterial spot (*Xanthomonas campestris* pv. *vesicatoria*), and bacterial speck (*Pseudomonas syringae* pv. *tomato*). Pythium root rot from the transplants carried over into the field. Two fungal leaf spots, early blight (*Alternaria solani*), and Septoria leaf spot (*Septoria lycopersici*), and two fruit rots, buckeye rot (*Phytophthora cactorum*), and blossom end rot also occurred. Other fruit diseases included the fungal and bacterial leaf diseases listed above. Tomato fruit also experienced a number of other physiological disorders such as catfacing, growth cracks, yellow shoulders, and sunscald. Fusarium wilt (*Fusarium oxysporum* f.sp. *lycopercici*), timber rot (*Sclerotinia sclerotiorum*), southern blight (*Sclerotium rolfsii*), and root knot nematode (*Meloydogyne incognita*) were problems in some fields. A number of viral diseases caused losses associated with TSWV (Tomato Spotted Wilt Virus) and ToMV/TMV (Tomato Mosaic Virus/Tobacco Mosaic).

Peppers. Bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria*) remains an important problem. Important virus diseases of pepper included pepper mottle and TSWV (tomato spotted wilt virus). Occasionally, southern stem blight (*Sclerotium rolfsii*) and stem rot (*Rhizoctonia solani*) were problems. Pythium root rot (*Pythium* spp.) was found, especially where associated with already infected transplants.

Cucurbits. Cucurbits are becoming more popular in Kentucky, and their diseases are increasing in economic importance. Phytophthora root rot, stem rot, leaf blight and fruit rot (*Phytophthora capsici*) is widespread in the state and causes losses in many fields of pumpkins, squash, and cucumbers. Microdochium blight (*Microdochium* sp. recently renamed *Plectosporium*) caused some damage in some fields that were not being sprayed well; the causes of poor spraying, even if being sprayed regularly, are poor timing, poor coverage, or use of the wrong fungicides. Watermelon and squash showed, respectively, Fusarium root rot and root and crown rot (*Fusarium* spp.) diseases. Nutritional disorders were also common, including several cases of manganese toxicity and blossom end rot. Anthrancnose (*Colletotrichum spp.*), gummy stem blight/black rot (*Mycosphaerella melonis*), and Cercospora leaf spot (*Cercospora melonis*) were found at serious levels in some fields on many of the cucurbits. The potyvirus complex, dominated by Watermelon Mosaic Virus 2, was widespread in pumpkin and winter squash, while several cases of Cucumber Mosaic Virus were also found in melon crops. Bacterial diseases of cucurbits included angular leaf spot (*Pseudomonas syringae* pv. *lachrymans*) and bacterial wilt (*Erwinia tracheiphila*). Symptoms of a newly emerging bacterial disease, Cucurbit Yellow Vine Decline caused by *Serratia marsescens,* were found in watermelon, muskmelon, summer squash, and winter squash.

Other Vegetables. Bean root and stem rot (*Pythium spp., Rhizoctonia solani* and *Fusarium solani* f.sp. *phaseoli*), bean anthracnose (*Colletotrichum lindemuthianum*), and pea stem rot (*Rhizoctonia solani*) were observed this year. Dry rot (*Fusarium* sp.) occurred on potato tubers.

Growers are urged to bring to the attention of their County Extension Agent any observations of new outbreaks and disease trends in their fields. We want to be especially watchful of the new spectrum of microbes and diseases that may occur with changes in fungicide use patterns from broad-spectrum protectant fungicides such as mancozeb and chlorothalonil to new chemicals such as Quadris and Abound, which present a greater risk of pathogen resistance to the fungicide while incurring reduced risks to human health and the environment. For example, we have noted increased bacterial diseases in tomatoes and now want to know if this is due to how we raise our crops, manage other diseases, or import seeds and transplants.

Because fruits and vegetables are high-value crops, the Plant Disease Diagnostic Laboratory should be a great value to commercial growers. However, many growers are not using this laboratory often enough or they are waiting until their disease problem has become well established. By then, it may be too late to do anything about it, or in some cases to correctly diagnose the sequence of diseases that may have led to the final outcome. Growers need to consult consistently with their County Extension Agents so that appropriate plant specimens are sent to the laboratory in a timely manner. We are urging County Extension Agents to stress in their Extension programming the need for accurate diagnosis of diseases of high-value crops. Growers can work with their agents to see that Kentucky growers have the best possible information on fruit and vegetable diseases.

Literature Cited

1. Bachi, P.R., J.W. Beale, J.R. Hartman, D.E. Hershman, W.C. Nesmith, and P.C. Vincelli. 2003. Plant Diseases in Kentucky—Plant Disease Diagnostic Laboratory Summary, 2002. UK Department of Plant Pathology (in press).

Appendix A: Sources of Vegetable Seeds

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

AAS .... All America Selection Trials, 1311 Butterfield Road, Suite 310, Downers Grove, IL 60515
AS/ASG .... Formerly Asgrow Seed Co., now Seminis (see "S" below)
AC .... Abbott and Cobb Inc., Box 307, Feasterville, PA 19047
AG .... Agway Inc., P.O. Box 1333, Syracuse, NY 13201
AM .... American Sunmelon, P.O. Box 153, Hinton, OK 73047
AR .... Aristogenes Inc., 23723 Fargo Road, Parma, ID 83660
AT .... American Takii Inc., 301 Natividad Road, Salinas, CA 93906
BBS .... Baer's Best Seed, 154 Green St., Reading, MA 01867
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
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
EX .... Express Seed, 300 Artino Drive, Oberlin, OH 44074
EZ .... ENZA Zaden, P.O. Box 7, 1600 AA, Enkhuisen, Netherlands 02280-15844
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
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
HN .... HungNong Seed America Inc., 3065 Pacheco Pass Hwy., Gilroy, CA 95020
HO .... Holmes Seed Co., 2125-46th St., N.W., Canton, OH 44709
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, ME 04910-9731
KS .... Krummrey & Sons Inc., P.O. 158, Stockbridge, MI 49285
KY .... Known-You Seed Co. Ltd. 26 Chung Cheng Second Rd., Kaohsiung, Taiwan, R.O.C. 07-2919106
LI .... Liberty Seed, P.O. Box 806, New Philadelphia, OH 44663
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.)
NZ .... Nickerson-Zwaan, P.O. Box 19, 2990 AA Barendrecht, Netherlands
OE .... Ohlsens-Enke, NY Munkegard, DK-2630, Taastrup, Denmark
OS .... L.L. Olds Seed Co., P.O. Box 7790, Madison, WI 53707-7790
P .... Pacific Seed Production Co., P.O. Box 947, Albany, OR 97321
PA/PK .... Park Seed Co., 1 Parkton Ave., Greenwood, SC 29647-0002
PE .... Peter-Edward Seed Co. Inc., 302 South Center St., Eustis, FL 32726
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
PS .... Petoseed Co. Inc., P.O. Box 4206, Saticoy, CA 93004
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
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, California 93030-7967

SI .... Siegers Seed Co., 8265 Felch St., Zeeland, MI 49464-9503

SK .... Sakata Seed America Inc., P.O. Box 880, Morgan Hill, CA 95038

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

SW .... Seedway Inc., 1225 Zeager Rd., Elizabethtown, PA 17022

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

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

ZR .... Zeraim Seed Growers Company Ltd., P.O. Box 103, Gedera 70 700, Israel

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Issued 12-2002, 1000 copies