PR-423

AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

1999
Fruit and Vegetable Crops
RESEARCH REPORT

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

1999 Fruit and Vegetable Crops Research Report

edited by Brent Rowell

Faculty, Staff, Student, Grower, and Industry Cooperators

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Contents

Fruit and Vegetable Program Overview

Dewayne L. Ingram, Chair, Department of Horticulture

The faculty, staff, and students involved in UK's fruit and vegetable programs are pleased to offer this 1999 research report. This is one way we share information generated from a coordinated research program involving several departments in the College of Agriculture. The research areas on which we concentrate reflect stated industry needs, expertise available at UK, available operating and labor support, and the nature of research projects around the world that generate information applicable to Kentucky. Dr. Brent Rowell is the editor of this report and coordinator of our multi-disciplinary team of faculty, staff, and students addressing the research and educational needs in Kentucky related to vegetable crops. 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, please find below some 1999 highlights of our Extension program and undergraduate and graduate degree programs addressing the needs of the horticultural industries.

Extension Highlights

Extension programs targeting Kentucky's fruit and vegetable industry include both highly visible and more subtle activities. Statewide, area, and multi-county educational meetings and on-farm demonstrations are probably the most visible. Publications, videos, slide programs, newsletters, articles in state and national industry magazines, newspaper articles, radio spots, and television programs are all-important, visible elements of our Extension program. Some of the more subtle but vital activities and services include training county Extension agents, the work of the Plant Disease Diagnostic Clinic, soil testing and interpretative services, and general problem solving.

Although there are many facets of the Extension program conducted by the team of subject matter specialists and county agents, allow me to focus on just three of our recently developed educational resource items. If you haven't seen *Commercial Vegetable Crop Recommendations 1998-99*, the new Cooperative Extension publication *Marketing Options for Commercial Vegetable Growers*, and the new instructional video *Tomato Production and Marketing*, please allow me to introduce them to you. Each of these are available through your county Cooperative Extension office and are also available online at <http://www.ca.uky.edu/agc/pubs/agpubs.htm>.

Commercial Vegetable Crop Recommendations 1998-99 (ID-36) is the compilation of production recommendations for over 30 commercial vegetable crops in Kentucky. This 120-page publication is written by a team of faculty from several departments and edited by Dr. Brent Rowell (UK Horticulture). The recommendations made in this publication are based upon field research, production experiences in several regions of the state, and pesticide regulations. The quality of this publication was validated by its receiving the 1999 Blue Ribbon Extension Publication Award, presented by the American Society for Horticultural Science, Southern Region.

Marketing Options for Commercial Vegetable Growers (ID-134) is a new publication by Dr. Rowell, Dr. Tim Woods (UK Agricultural Economics), and Jim Mansfield (Kentucky Department of Agriculture Marketing Division). This eight-page publication provides characteristics of the commercial vegetable markets and various proven avenues for accessing those markets. This is a "must-read" publication, given the fact that market drives profitable production, and marketing strategies are among the first decisions for successful vegetable crop managers.

The *Tomato Production and Marketing* instructional video (VHO-1265) is a 20-minute introduction to commercial tomato production from the perspective of growing for specific markets. You will find that the refreshing approach of this video will keep your attention while providing a fairly detailed overview of the primary characteristics of tomato production and the requirements for a profitable enterprise. The presentation is designed especially for new producers and tobacco growers considering new crop alternatives.

Undergraduate Program Highlights

The Department of Horticulture 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 1999:

The plant and soil science degree program had over 100 students in the fall semester of 1999, of which almost one-half are horticulture students and more than one-third are turfgrass students. Nineteen horticulture students graduated in the past year.

We believe that a significant portion of an undergraduate education in horticulture must come from outside the classroom. In addition to the local activities of the UK Horticulture Club and field trips during course laboratories, students have excellent off-campus learning experiences. Here are the highlights of such opportunities in 1999:

- A three-week study tour of China involving 12 students was led by Drs. McNiel, Dunwell, Geneve, and Nieman.
- Horticulture students competed in the 1999 Associated Landscape Contractors of America (ALCA) Career Day competition in Lexington in March (Dr. Robert McNiel, faculty advisor). We hosted the event, which had representatives of more than 40 colleges and universities from New York to California.
- Students accompanied faculty to the American Society for Horticultural Science Annual Conference, the Kentucky Landscape Industries Conference and trade show, and the Southern Nursery Association trade show.

  At least one internship is required for all horticulture students. Students have internships in Kentucky, throughout the United States, and in other parts of the world. Students have interned recently in Australia, Shelby Gardens in Sarasota, FL, and the Denver Zoo and Botanic Garden.

Graduate Program Highlights

The demand is high for graduates with a master's degree or doctorate with an emphasis in horticulture, entomology, plant pathology, agricultural economics, or biosystems and agricultural engineering. Our master's degree graduates are being employed in industry, Cooperative Extension, secondary and post-secondary education, and governmental agencies. Last year, there were eight graduate students in these degree programs conducting research directly related to the Kentucky fruit and vegetable industry.

Graduate students are active participants in our research program and contribute significantly to our ability to address problems and opportunities important to Kentucky horticulture. The demand for graduates and the need for graduate research greatly outstrip the funds available for student support, infrastructure to support their work, and our ability to recruit students into this field of study.

Tomato Saviors, Silver Bullets, and Tobacco Alternatives

Brent Rowell, Department of Horticulture

Headline writers yearn for the killer hookline. Unfortunately, headline writers are not the same people who write the articles. I learned this the hard way, when an otherwise objective *Lexington Herald Leader* article on tomato production was crowned with "Can a Tomato Save Kentucky's Farms?"[1] I had heard of killer tomatoes, but savior tomatoes were entirely new to me. The lead sentence stated the real theme of the article: "Could a Kentucky tomato help ease small farmers' dependence on tobacco income?" "Save" and "ease" have entirely different meanings. The gist of the article was that staked tomato production might be an opportunity for some tobacco growers seeking to diversify.

Bad headlines often lead to worse headlines. The savior tomato story was used by the Associated Press and then by National Public Radio. A new headline, "Ag Experts See Tomato as Possible Substitute for Tobacco," bore little relationship to the original article.

Why the frequent exaggeration and overkill on this topic? I believe the press and the non-farming public like the idea of a savior for the tobacco farmer. They like the idea of a panacea, a cure-all, a green silver bullet—that *one thing* that will help tobacco go away without causing pain and hardship for folks who have been leaf-dependent for centuries. As one of our local growers put it a few years ago: "It's relatively easy and seemingly convincing for these sources who are not in the nitty-gritty dirt business to espouse idealistic approaches."

Tobacco farmer salvation is being touted by all sorts of evangelists these days. Even state government officials have succumbed to the temptation to proclaim single solutions. The day after the saving tomato story broke, NPR aired a good story on aquaculture. A state lawmaker could not resist saying confidently that aquaculture was the thing that could help most Kentucky tobacco growers.

So add to the staked tomato savior a fish or shrimp savior, an organic farming savior, a pawpaw savior, a Kentucky vineyard savior, perhaps a mushroom savior, and, let's certainly not forget, that controversial hemp savior. And then there are those who believe that real salvation lies only with industrial growth providing more off-farm employment and thereby further reducing the number of Kentucky farms. While off-farm employment may continue to be the most common consequence of declining tobacco, it is of little comfort to those who would prefer to continue farming.

What's wrong with this picture? Maybe nothing if these and other alternatives are considered *together*. The problem is the irresistible urge to proclaim a single commodity, enterprise, or industry as the one thing above all others that will somehow replace lost tobacco income.

Growing and marketing Kentucky premium tomatoes might be an alternative for some tobacco growers. Fish or shrimp farming may help others. Sweet sorghum has good possibilities in some areas. Other horticultural enterprises like medicinal herbs or native plant nurseries may work for still others. There are a host of opportunities and possibilities. Most of them need further exploration and development, and none of them deserves single solution status.

Getting Realistic about Vegetables

There have been all sorts of claims and speculations—but few level-headed discussions—about how to make up for declining tobacco quotas. Fruit and vegetable production will always be on the front lines of any such discussion, since the potential returns on small acreages are comparable to tobacco. And unlike the current status of many traditional Kentucky farming activities, *markets are expanding, and commercial vegetable production is profitable*.

Net returns/acre from several popular vegetable crops equal or exceed returns from tobacco. The impact of our on-farm demonstration program on tobacco growers has been well documented.[2] Tobacco growers not previously growing vegetables have commonly added $3,000 (net returns) to farm income from a 1-acre demonstration plot. Those already growing vegetables usually doubled farm income by participating in the program and adopting recommended varieties coupled with drip irrigation.

But how many tobacco growers will be able to benefit from a transition to vegetable crop production? Few people are aware of the projections made over a decade ago by Harold G. Love, then UK Agricultural Economics professor, and master's level student James R. Mansfield[3].

Mansfield's important 1986 study looked at the potential impact of vegetable crops as tobacco alternatives when sold through various marketing channels. He considered farms located in the burley-producing region, defined as the area bounded by I-65 on the west, I-75 on the east, the Ohio River on the north, and the Tennessee border to the south.

At that time (1982 data) there were reportedly 50,515 small tobacco farms (gross sales less than $40,000) in Kentucky, of which about 75%, or 37,886, were within the region described above. Only about half of these, or 18,943 farms, were considered actual producers (not leasing out their quota). Professor Love's analysis stated that "a viable Kentucky fresh market vegetable industry" could successfully penetrate an 11-city regional market area and that sales of a 10% market share to this area would amount to approximately $35.2 million. This would amount to $1,858 in gross sales for each of the 18,943 farms.

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[1] Business Monday, *Lexington Herald-Leader*, 30 August 1999.

[2] *Pumpkin Patches on Tobacco Road—Improving Horticultural and Other Farm Product Marketing Opportunities in Tobacco Communities.* Commodity Growers Cooperative Assn. 1998. Lexington. 72 p.

[3] Love, Harold G., A. Jermolowicz, and F. Stegelin. 1986. Prospects for Kentucky Agriculture: Horticulture. in *Prospects for Kentucky Agriculture: A Resource Document*. Univ. of Kentucky. 526 p. Mansfield, James R. 1987. *Comparing Marketing Channels for Kentucky Fruits and Vegetables*. M. S. thesis. Dept. Agricultural Economics, Univ. of Kentucky.

Further speculation assumed that farmers on only half of these farms would be interested in participating in wholesale produce marketing; and therefore, gross sales for these 9,471 farms would be $3,716/farm. This amount, according to the author, would begin to rival tobacco income on many small farms.

Although we do not know precisely how many "small tobacco farms" exist today, we do know that the number of tobacco farms declined by nearly 40% in the 15-year period from 1982 to 1997. In addition, values of most vegetable products have risen considerably since 1986. The gross sales figures and potential impacts of vegetable production on small farms would be considerably higher if the same assessments were calculated for 1999.

Mansfield concluded that high volume sales to area retail and wholesale produce distributors was the most promising marketing channel in terms of replacing declining tobacco income. Recent advertising and promotion notwithstanding, retail and wholesale distributors in the state purchase a very small percentage of produce from Kentucky growers. Most of the produce moved through these channels is purchased from grower-shippers in the major vegetable producing states, supplied by national wholesalers, or is purchased through terminal markets.

Only about 5% of the fresh vegetables consumed in Kentucky have been grown in the state. Although it is not possible for Kentucky growers to supply the quantities required throughout the year, locally grown vegetables provide many advantages to the consumer. A conservative and obtainable goal would be for Kentucky growers to supply a third of the fresh vegetables consumed within the state during our four-month marketing season. Kentuckians consume over 600 million pounds of fresh vegetables each year. If local growers could provide a third of summer consumption, this would amount to 73 million pounds of produce grown on approximately 2,500 acres, adding over $18 million to the agricultural economy.

Direct marketing, considered promising in 1986, is becoming increasingly important in Kentucky as in most other parts of the country. A 1999 survey indicated that direct marketing (farmer's market sales, roadside stands, U-picks, etc.) may account for up to 55% of current produce sales in the state as opposed to around 37% in the mid-1980's[4] . The $35.2 million sales projection cited above, considered both "conservative and realistic" at the time, did not include sales from direct marketing.

What are the chances of Kentucky developing the "extensive fresh market vegetable industry" that Love and Mansfield's estimates were based upon? All indications are that development of this industry is both feasible and practical. Kentucky is located within a 10-hour drive of 20 of the nation's largest cities and within a two-day drive of an additional 20. These 40 cities have a combined population of over 185 million served by more than 20,000 supermarkets.

The value of produce that Kentucky growers supplied through wholesale channels was estimated to be only $6 million in 1991. This amounts to only about 1/10 of 1% of the total value of vegetables produced in the United States. Given this underdeveloped status, it should be possible for Kentucky to increase its market share sixfold to 0.6%, which would increase crop value by about $50 million. This would match current production levels in Tennessee. It should be possible to increase vegetable production sold through all marketing channels to $100 million. Although this does not approach tobacco in total crop value, it could have tremendous impact if dispersed among many small farms in tobacco-dependent counties.

The Coleslaw Solution

There are still lingering hopes and dreams floating around that vegetable processing facilities could somehow save Kentucky farms. This requires a greater leap of faith than any of the marketing options previously discussed. Building new processing facilities is very attractive to those unfamiliar with the industry or its history in the state. Unfortunately, continuing long-term trends in that industry make Kentucky an unfavorable location for expanding most types of vegetable production for processing.

Nationwide consumption and demand for many canned and frozen vegetable products have been flat or are in a state of decline. It is also true that consumption of fresh-cut items and those using tomato or pepper-based products (salsa, pizza, etc.) continues to rise. But rising consumption patterns may not translate into increased opportunities for Kentucky growers in this case.

Vegetable production for processing has all but disappeared from Kentucky. Most processors have moved to the regions of supply where economies of scale permit buying large volumes at the lowest possible cost. There were no more cucumbers grown for processing in the state after Dean Foods bought and closed Louisville's Paramount Foods in 1995. None of the half-dozen or so pepper processing companies remain active in the state, and 5,000 acres of processing peppers have dwindled to nearly nothing in 1999. Moody Dunbar, a pepper processor based in east Tennessee with a long history of operations in Kentucky, now buys most of its peppers from California, where its largest facilities are located.

Six potato chip plants were once located in or near Kentucky, but low prices and economies of scale meant that only one or two large western Kentucky growers could profit from this market. There were once over 2,000 acres of processing snap beans in and around Wayne County; production ended when the company closed its Tennessee plant. Tennessee had its own thriving processing snap bean industry centered around Crossville, but low prices forced the majority of these growers into production for the fresh market.

The latest vegetable processing venture occurred in western Kentucky, where millions of dollars were invested in tomato processing facilities and equipment before those involved learned the hard lessons taught by low prices, economies of scale, and fierce competition. That venture passed away in 1997.

Recent discussions have centered on establishing a large fresh-cut vegetable operation in Kentucky. While this is definitely a growth industry, as consumers purchase increasing amounts of packaged salad mixes and other minimally processed products, there are some obvious problems which have yet to

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[4] See *State Fruit and Vegetable Survey Highlights* in this report.

be considered. There are pressures for low prices and economies of scale in this business as in other processing enterprises.

It has been difficult, for example, for Kentucky growers to supply the state's few existing fresh-cut businesses with cabbage that can compete in price and quality with cabbage produced by large growers in upstate New York. There are also obvious advantages in a state like New York, where cabbage growers have invested and continue to invest hundreds of thousands of dollars in research and development on improving production for this market.

Other ominous clouds appear to be looming on this market horizon. Several large California produce companies recently closed their fresh-cut operations after buyers forced them to absorb all new costs associated with product liability and food safety protection.

None of the vegetable crop alternatives are easy or as easy as tobacco. Getting into most horticultural enterprises is risky business. It is also hard work, and there are obstacles and pitfalls along the way. Overcoming obstacles and reducing risks will require changes in farming traditions, adjustments to new marketing systems, changes in university programs, and new infrastructure investments.

Real Men (in Kentucky) Grow Tobacco

Tobacco growing is arguably the oldest farming tradition in America. By comparison, starting a vegetable production enterprise seems daring and difficult in many Kentucky counties. It requires new thinking about farming and can lead to cultural changes in farm communities. Although growing broccoli may not be that much different from growing tobacco, it means doing something different from what has been done for centuries. It means new and unfamiliar conversations at local stores and lunch counters. It means more attention to detail and more concerns about timing, markets, and marketing.

As an Extension specialist, I'd like to think farmers get most of their information from county agents backed up by specialists. Many do, and innovators often do. But it is well known that farmers get much of their information from other farmers, learning a great deal from the example of others in their own communities. The farmer-innovator, that brave soul who is the first to start vegetable production, is likely to suffer from bouts of loneliness. He or she may feel quite isolated in terms of information, example, and assistance. The farmer-innovator may even be laughed at when looking for help at the local ag supply store (true story) and will also have a tough time finding some of the most effective minor-use pesticides.

Are changes in long-established crops and associated farming traditions really possible? Not only are they possible, but watershed changes are taking place now and have taken place throughout Kentucky's history. Over 250,000 pounds of Kentucky tobacco were marketed in New Orleans in the year 1790. By the end of that same year, the Spanish had limited future tobacco purchases to a mere 40,000 pounds annually—the equivalent of a single flatboat load. Although this was a major shock for most Southern planters, Kentuckians turned in great numbers to wheat and hemp production.

Setting aside for a moment hemp's current controversial status, consider it as an example of how major upheavals have occurred in Kentucky agriculture. Kentucky hemp production peaked in 1859, with 40,000 tons of fiber grown on approximately 100,000 acres. Kentucky became known all over the world for its quality hemp production. But by the end of that century the advent of steamships and petroleum engines had severely reduced the demand for hemp rope and sails. The remaining but greatly diminished demand could then be supplied by cheap Russian imports. Although revived briefly during the Second World War, hemp production disappeared after the government canceled growing permits at the war's end. There are some striking parallels in the changes that took place in hemp production at the end of the 19th century and those occurring in tobacco at the end of the 20th.

Even major vegetable production regions were not always so. The Salinas Valley in California, the world's largest salad bowl, produces 12,500 tons of tomatoes, 15,000 tons of strawberries, and 82,000 tons of lettuce each year. But the valley was once used primarily for cattle ranching and later for sugar beet production. The vegetable tradition (more accurately an agricultural revolution) developed only in the 1920s. Three hundred acres of lettuce planted around Salinas in 1922 had grown to 43,000 acres by the end of that decade.

Georgia peanut farmers are not known as the most innovative farmers in the world, and many Kentucky growers would consider themselves equal or even more daring than their Georgia counterparts. But a growing number of Georgia peanut growers have become world class vegetable producers. Farm income from vegetables continues to rise in Georgia, surpassing peanuts in 1995, and is now second only to King Cotton. Farm income from vegetables increased from $180 million in 1989 to $434 million in 1995.

The real question is not whether significant changes will take place, but whether Kentucky can adapt to new realities and manage what is hopefully a gradual transition to new crops and their unfamiliar marketing systems.

Reducing Risks, Building Foundations

Vegetable production is inherently riskier than tobacco production, and most tobacco growers are keenly aware of this fact. It is tobacco's enviable and long-established cooperative marketing system which eliminates many of the risks for growers. Tobacco production is regulated and limited and based in part on buying intentions. Prices are held high, and surpluses can be brought in to be sold later.

Vegetable crops are highly perishable, and vegetable marketing is often a free market adventure. Prices are volatile and cause grower returns to fluctuate. There are no quotas, no pools, no support prices. Most products cannot be stored and sold later. "Sell it or smell it" is still a good rule of thumb in the produce business.

What can be done to help reduce these risks for new Kentucky growers? The word infrastructure often comes to mind. Infrastructure is the underlying support system for a building, government, community, or industry. It is the foundation required to support construction and growth. Marketing infrastructure development has often been discussed and advocated in these pages. The good news is that Kentucky is making significant progress in establishing a serious marketing infrastructure for crops other than tobacco.[5]

Small farmer cooperatives are important components of infrastructure building. Minimum purchase volumes required by major buyers generally preclude small farms as individual suppliers. Grower-owned cooperatives can assemble marketable shipments of fresh produce and help minimize risks by providing cooling and packing facilities.

These groups of new and experienced growers learn from each other and have something in common to talk about. A new cooperative can become a center of production where a critical mass of serious vegetable growers can establish a foothold in Kentucky. It can become a catalyst for change in farming culture and traditions. This is already happening in parts of south-central Kentucky in association with the Cumberland Farm Products Cooperative. Growers are attempting to replicate that success with new vegetable co-ops in eastern Kentucky, in the Bluegrass region, and in the Mammoth Cave area.

Land grant universities and the Cooperative Extension Service are also vital components of vegetable production and marketing infrastructure. The universities and the Extension service must become more adept at responding to major changes in agriculture and to shifting demands of the marketplace.

After examining farming trends reflected in the 1997 Kentucky Census of Agriculture, one UK economist has called for the College of Agriculture to devote its primary efforts toward enterprises where the per capita consumption is rising and to devote considerable resources to assisting small farmers who earn most of their income from off-farm sources.[6]

Because crop varieties, pest management recommendations, and irrigation techniques are also constantly changing, a statewide applied research network for vegetable and other horticultural crops is essential to ensure that Kentucky growers can remain competitive. Growers are constantly faced not only with serious production problems, but also with important issues like food safety and labor management. Significant investments in the state's applied research on vegetable crop production systems for small and part-time farmers must accompany marketing infrastructure development. This investment will require a solid foundation of adequately staffed and funded field stations in at least three major physiographic regions of the state.

The present system is inadequate to the task and will need a major push forward if the goal of an extensive and sustainable fresh market vegetable industry is to be realized. Our statewide roster of permanent research farm personnel for vegetable crops reads as follows: one farm manager, one farmhand, and one technician—not even enough to draw a flow chart. These same three people also work with a number of other horticultural crops. Kentuckians should decide for themselves whether this "system" is adequate for the task at hand as they enter the 21st century.

Multiple Choices

Much of what has been discussed in this paper depends upon Kentucky building a strong foundation to support stability and growth in the fresh vegetable industry. This is not an elusive silver bullet. Developing a viable fresh vegetable industry is only one promising alternative among many new, possible small farm enterprises.

Kentucky has been handed an incredible and unprecedented opportunity. The state is expected to receive $138 million annually for the next 25 years from Phase I of the National Tobacco Settlement. The approaching social and economic losses to tobacco-dependent rural communities are severe and have been documented. What better way to invest a portion of this money than to plow it back into efforts to assist those most affected by changes in tobacco? Both the farming and non-farming public seem to agree on this point: a study conducted last March by the UK Survey Research Center revealed that an overwhelming majority of Kentuckians (85%) thought settlement dollars should be used to help farmers grow other crops.

All major farm groups have come to agree on what is now called the Unified Plan for Agricultural Development in Kentucky. The horticulture component of this plan calls for $2 million in annual funding for the continuation of the Kentucky Department of Agriculture's ongoing marketing infrastructure development and promotion programs. This amount also includes funding for regional marketing specialists.

The horticulture plan also calls for capital investments of $6.8 million over the first three years for expansion and improvement in horticultural research and educational facilities in Eastern, Central, and Western Kentucky. This amount includes funding for a major expansion of our ongoing hands-on demonstration program.

Recurring funds of $2.2 million will pay for new research farm personnel and technical staff in support of statewide applied research and Extension programs. Perhaps one of the most critical uses of these funds will be to hire new regional Extension staff with specialized knowledge of vegetable crop production technology.

The horticulture plan will help reduce risks considerably for tobacco growers looking for new crop alternatives. Every dollar invested in this way is expected to return more than $3 in increased sales of horticultural products over a 10-year period. The impact of doing nothing should be painfully obvious to anyone who received the 20% pay cut as a result of last year's quota reductions.

Kentucky has come to a crossroads at century's end. Kentucky citizens and their elected representatives must now decide which road to take. One road prepares for change by building a solid foundation for a new and different agricultural future. Travelers on the other road linger with talk of tomato saviors and silver bullets.

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[5] See "Revisiting the 'A' Word: Horticultural Opportunities 1998-1999." *NewHarvest.* Winter 1998.

[6] Debertin, David L. 1999. The 1997 Kentucky Census of Agriculture, Projections for 2002 and 2007 and Implications for the College of Agriculture. Dept. Agricultural Economics, Univ. of Kentucky. Publication RIS-99-2.

State Fruit and Vegetable Survey Highlights

Tim Woods, Department of Agricultural Economics

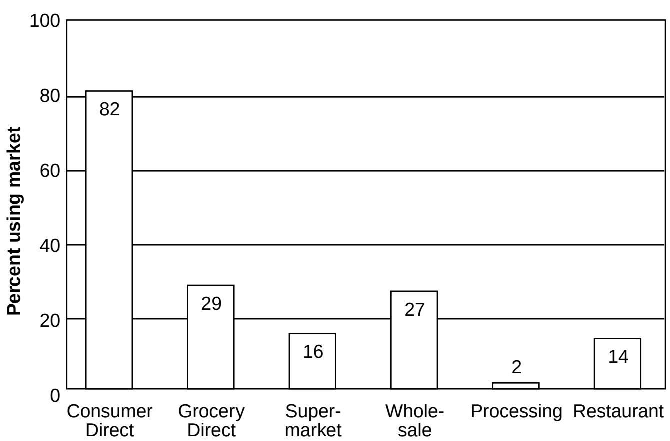
The Kentucky Partnership for Food Safety and Quality Assurance is an initiative within the University of Kentucky organized to assess food quality and safety needs in horticultural and other agricultural enterprises. This group conducted a survey this summer of fruit and vegetable producers throughout Kentucky. Several interesting marketing trends and facts were confirmed through this survey, and here are some of the highlights. More detailed findings will be forthcoming in a report being prepared by the University of Kentucky.

More than 200 usable surveys were completed from our sample of Kentucky producers. The sample represents a selection of producers who receive *NewHarvest*, those listed in the Kentucky Department of Agriculture Directory, and those involved in the Farm Bureau Roadside Market program. The list was selected in such a way as to create a representative sample that would reflect the marketing activity of all fruit and vegetable producers in the state. Survey results indicated some interesting marketing patterns among our fruit and vegetable producers.

Market Utilization

An overwhelming majority of the produce growers in the state sell at least some of their produce through direct marketing channels like farmers' markets, roadside stands, or U-picks. The 82% of growers indicating they sell through these direct markets well exceeded the next most frequently identified marketing channel, which was direct to retail (sales to a local grocery or other retail sellers). Direct to retail was used by 29% of the respondents. The percentage of producers indicating their selling activity by marketing channel is shown in Figure 1.

Figure 1. Markets used by Kentucky farms.



Market Diversification

The majority of growers indicated they use several marketing channels. Produce is being sold into two or more different market channels by 52% of those responding (Figure 2). Diversification of market channels allows larger-volume producers to take advantage of opportunities in local markets while still producing for wholesale distribution. Still, nearly half of the farmers indicated they focus their sales to a single market.

Distribution of Sales

Farmers were asked to indicate their 1998 total sales as well as the percent sold into each market. Their gross sales are reported by market channel in Figure 3. Interestingly, 55% of the total sales farmers reported from 1998 were from direct marketing channels.

There was a total of nearly $3 million in sales reported from the survey respondents, with $1.6 million reported in direct sales. If the sample is a good indication of marketing activity of fruit

Figure 2. Market diversification.

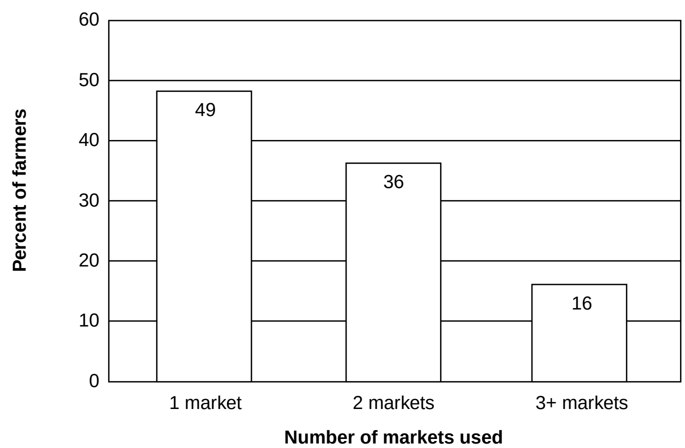
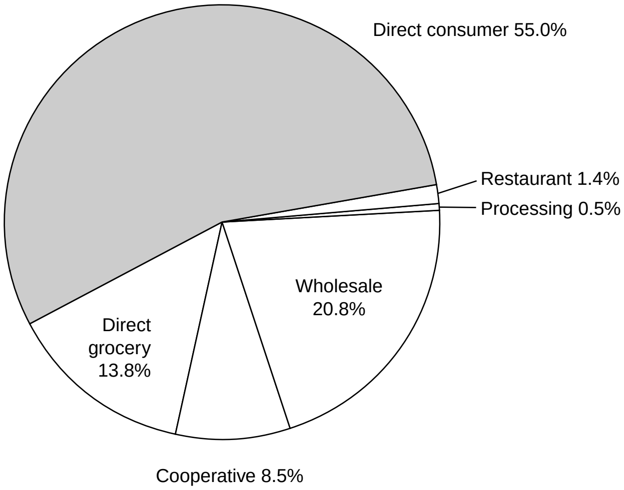


Figure 3. Distribution of sales.



and vegetable producers in the state, then direct marketing can be considered a very important component. The importance of direct marketing, however, does not diminish the importance of wholesale markets or their potential for growth. Wholesale markets are important to the balance and viability of a total marketing system, and most sales through Kentucky cooperatives go through wholesale distribution channels. It is interesting that a significant proportion of Kentucky farmers are involved in direct selling and that the value of sales generated in this market channel can no longer be regarded as minor or secondary.

On-Farm Commercial Vegetable Demonstrations

Dave Spalding and Brent Rowell, Department of Horticulture

Introduction

The Department of Horticulture has been conducting on-farm demonstrations with commercial vegetables for over a decade. Most of these demonstrations have been established at the request of interested tobacco growers in cooperation with their county Extension agents. It has been necessary to reduce the number of demonstrations since 1998 as a result of the additional time required by the Extension associate assisting the new Central Kentucky Vegetable Growers' Cooperative.

On-farm demonstrations were conducted in 1999 in Bracken, Lewis, and Mason counties. The grower/cooperator in Bracken County grew 0.8 acres of bell peppers, and the cooperator in Lewis County grew 1 acre of peppers. There were two cooperators from Mason County: one grew 1 acre of bell peppers, and the other grew 2 acres. Department of Horticulture specialists also worked closely with first-time commercial vegetable growers in Marion, Mercer, and Nicholas counties. The growers in these counties generally represented larger farming operations looking at vegetable production to reduce their dependence on tobacco and to more efficiently utilize migrant labor employed in tobacco production. Data from bell pepper production in Mercer County (Anderson Circle Farms) and Nicholas County (Caswell Farms) are included in this report. In addition, the Extension associate worked closely with a new grower in Marion County who had 5 acres of staked tomatoes; his production data were not available at the time of publication.

Materials and Methods

As in previous years, grower/cooperators were provided with transplants, black plastic mulch, drip irrigation lines, and the use of 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, the county Extension agents took soil samples from each plot and scheduled, promoted, and coordinated field days at each site. The Extension associate from the University of Kentucky made regular weekly visits to each plot to scout the crop and make appropriate recommendations.

The demo plots were to have been transplanted to three different bacterial spot-resistant varieties (Boynton Bell, Enterprise, and Lexington). However, about three weeks before transplanting, the locally grown transplants were found to be infected with Impatiens Necrotic Spot Virus (INSV), and those transplants could not be used. Replacement plants were eventually located in northern Ohio. Peppers were transplanted into 6 in. high raised beds covered with black plastic with drip lines under the plastic. Plants were transplanted in an offset manner in double rows and were spaced 12 in. apart in the row with the rows spaced 15 in. apart. Raised beds were 6 ft from center to center. The plants were sprayed with appropriate fungicides and insecticides on an as-needed basis, and the cooperators were asked to follow the fertigation schedule provided.

The larger growers in Mercer and Nicholas counties provided all their own inputs and equipment. The Extension associate made regular visits to those operations to scout the crop and make recommendations. Production practices on these farms were essentially the same as those for the smaller demonstration plots, although on a larger scale.

Results and Discussion

In a very difficult crop year with extreme drought in much of central and eastern Kentucky, producers who had adequate water and transplanted on time had relatively high yields and returns. The small demonstration cooperators were late in getting their crops in because of diseased locally grown transplants that had to be replaced with plants grown farther north. These northern plants were very young and small when transplanted 10 to 15 days later than originally planned. These conditions contributed to a low early fruit set and the loss of early production when prices are traditionally higher. The Lewis county plot was the last to be transplanted and had almost no early production due to the extreme heat conditions that existed when those plants were flowering and setting fruit. In addition to the early heat problems, the water source for this plot proved to be inadequate later in the season when water requirements were highest. The result was a very poor yield and a very low return, as reflected in the accompanying data (Table 1). The 2-acre plot in Mason County was unfortunately destroyed by a hailstorm on 22 June. By contrast, the Anderson Circle and Caswell Farm crops were transplanted on time and for the most part had adequate water. These first-time growers had higher yields, resulting in considerably higher net returns/acre (Table 2).

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

Inputs	Bracken County (0.8 acre)	Mason County (1.0 acre)	Lewis County (1.0 acre)
Plants	$580	$725	$725
Fertilizer	$166	$15	$45
Black Plastic	$84	$105	$105
Drip Lines	$110	$140	$140
Fertilizer Injector	$55*	$55*	$55
Herbicide	--------	--------	---------
Insecticide	$68	$60	$15
Fungicide	$88	---------	---------
Water	$700	$1,031	$300
	(235,000 gal)	(275,000 gal)	(130,000 gal)
Labor	$965	$1,490	$340
	(193 hrs)	(260 hrs)	(51 hrs)
Machine	$232	$316	$33
	(50 hrs)	(68 hrs)	(7 hrs)
Total Expenses	$3,049	$3,937	$1,758
Yield	19,415 lb	24,780 lb	2,400 lb
Green	15,675 lb	19,080 lb	---------
Red	3,740 lb	5,700 lb	2,400 lb
Income	$3,268	$5,072	$238
Net Income	$218	$1,135	($1,519)
Net Income/Acre	$273	$1,135	($1,519)
Dollar Return/ Dollar Input	$1.07	$1.29	$0.14

*Prorated for multi-year use.

One of the primary benefits realized by the larger growers but not reflected in data was the better utilization of migrant labor that those farms employed in their tobacco enterprises. This is an important factor in their plans to increase vegetable production on those farms in the year 2000.

Table 2. Bell pepper costs and returns for larger grower/cooperators.

Inputs	Anderson Circle Farm (5.0 acres)	Caswell Farms (2.0 acres)
Plants	$3,393	$1,150
Fertilizer	$2,408	$188
Black Plastic	$525	$320
Drip Lines	$700	$404
Fertilizer Injector	$75	$55*
Herbicide	$180	--------
Insecticide	$460	$72
Fungicide	$590	$102
Water	$2,180 (1,240,000 gal)	$800 (480,000 gal)
Labor	$5,538 (850 hrs)	$1,910 (318 hrs)
Machine	$581 (125 hrs)	$ 432 (85 hrs)
Total Expenses	$16,629	$5,434
Yield	178,161 lb	53,925 lb
Green	79,325 lb	53,925 lb
Red	98,836 lb	------------
Income	$27,637	$9,207
Net Income	$11,007	$3,773
Net Income/Acre	$2,201	$1,887
Dollar Return/Dollar Input	$1.66	$1.69

*Prorated for multi-year use.

Rootstock and Interstem Effects on Pome and Stone Fruit Trees

Gerald R. Brown and Dwight Wolfe, Department of Horticulture

Introduction

Although apples are the principal tree fruit grown in Kentucky, the hot, humid summers and heavy clay soils in Kentucky make apple production a more difficult task for growers in this state than for major apple-producing regions where soil and climate are more favorable. Poor plum tree survival due to our heavy clay soils has also limited production of this tree fruit, and peach production can be expected to be erratic as a consequence of extreme temperature fluctuations that occur in the winter and spring. In spite of these challenges, productive orchards are one of the highest/acre income enterprises suitable for upland rolling soil that have a low potential for soil erosion. Kentucky still imports more apples than it produces, and the strong market for peaches continues to encourage growers to plant peach trees. Continued identification of improved rootstocks and cultivars is required for growth of the Kentucky fruit industry. For these reasons, Kentucky continues to be a cooperator, along with 39 other states and three provinces of Canada, in the Cooperative Regional NC-140 Project: Rootstocks and Interstem Effects on Pome and Stone Fruit.

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 six NC-140 rootstock plantings:

I. 1990 apple cultivar/rootstock planting consisting of five cultivars on six different rootstocks and replicated six times/rootstock. Trees are spaced 8 ft apart within rows 16 ft apart.
II. 1993 apple rootstock planting consisting of 'Liberty' on six rootstocks and eight replications/rootstock. Trees are spaced 16 ft apart within rows 23 ft apart.
III. 1994 apple rootstock planting consisting of 'Red Gala' on six rootstocks and 10 replications/rootstock. Trees are spaced 13 ft apart within rows 18 ft apart.
IV. 1999 dwarf and semi-dwarf apple rootstock planting consisting of two groups of apple rootstocks:
    i) dwarfing group with 11 rootstocks and planted on a 10 x 16 ft spacing.
    ii) a semi-dwarfing group with six rootstocks and planted on a 13 x 20 ft spacing.
V. 1990 plum rootstock planting consisting of 'Stanley' plum on 10 different rootstocks and seven replications/rootstock. Trees are spaced 16 ft apart within rows 20 ft apart.
VI. 1994 peach rootstock planting consisting of 'Redhaven' peach on 12 different rootstocks and eight replications/rootstock. Trees are spaced 16 ft apart within rows 20 ft apart.

Except for the 1990 apple cultivar/rootstock planting, trees of each rootstock were allocated to blocks (rows) in a randomized block design [i.e., each rootstock appears once and at random within each block (row)]. In the 1990 apple cultivar/rootstock planting, trees of each cultivar/rootstock combination were allocated to the blocks in a split-plot design [i.e, groups of six trees (each on a different rootstock) of each cultivar were randomly allocated to each block (row). Soil management is 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 such as soluble solids were measured annually for each planting.

Results and Discussion

The winter of 1999 in Kentucky was mild, followed by a wet spring and severe drought through the late summer and fall. Fruit generally had variable quality due to the drought. The effect of drought was greater on late-season maturing cultivars.

I. 1990 Apple Cultivar/Rootstock Planting

The 1990 Apple Cultivar/Rootstock Planting continues the evaluation of promising rootstocks identified from previous trials at the UK Research and Education Center while also evaluating cultivars/rootstock interactions. This planting is our first trial to be trained to the Dutch slender spindle system and supported by electrical conduit fastened to a wire trellis. This is one of a number of orchard systems that have been developed in Europe to reduce labor requirements and to enhance early production. Eastern and Midwestern growers are rapidly adopting this production technique, and it is appropriate that UK provides our growers with information on this system's performance. The chief advantage of this system is early production and reduced labor inputs. Early production allows growers to quickly establish orchards with newer, more profitable cultivars.

One hundred sixty-one trees of a possible 180 are in our test because three cultivar-rootstock combinations (Golden Delicious/EMLA M.9, Jonagold/Bud.9, and Liberty/Ott.3) and one tree of Liberty/Bud.9 were not available for this planting. A trellis system was constructed in 1992. Based on foliar analysis and visual observation of vegetative growth, no nitrogen was applied in 1993-99. Vegetative growth is now in the high-normal range. With the controlled vigor, the surviving trees are developing nicely. All pest control decisions are based on IPM procedures; the same as are used by our more progressive growers. Fire blight was very light in 1999. Nevertheless, 84 of the 161 planted trees (52%) have not survived, and significant differences in mortality by rootstock and cultivar were observed (Tables 1 and 2).

Both rootstock and cultivar significantly influenced cumulative yield, 1999 yield, picked fruit, dropped fruit, average fruit weight, and trunk circumference (Tables 1 and 2). Percent soluble solids and fruit pressure were significantly affected by cultivar (Table 1), but not by rootstock. The number of root suckers varied significantly by rootstock, but not by cultivar (Table 2). Significant cultivar by rootstock interactions were only observed for dropped fruit, average fruit weight, and fruit pressure (Table 3).

Table 1. 1999 cultivar results NC-140 1990 apple cultivar/rootstock planting[1].

Cultivar[2]	Cumulative Yield per Live Tree (lb)	Picks (lb/tree)	Drops (lb/tree)	1999 Yield (lb/tree)	Average Fruit Wt (oz)	Mean Pressure of Blush & off Sides (lb)	Percent Soluble Solids	Number of Suckers	Trunk Circum. (in.)	Percent of Trees Alive
Liberty	397	33	22	55	3.7	23.1	14.0	4.1	10.9	66
Golden Delicious	377	62	11	73	5.3	19.0	15.5	2.8	11.9	37
Jonagold	337	66	13	79	6.4	16.0	13.4	2.1	12.1	23
Rome	280	13	22	35	7.5	22.0	14.2	1.3	11.9	39
Empire	243	42	7	49	4.1	21.4	12.2	6.1	9.0	72
Mean	313	40	15	53	4.8	21.1	13.5	3.9	10.7	48
LSD (.05)	90	20	7	20	1.0	1.3	0.8	3.9	1.5	N/A

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] Arranged by cumulative yield in descending order.

Table 2. 1999 rootstock results NC-140 1990 apple cultivar/rootstock planting[1].

Rootstocks[2]	Cumulative Yield per Live Tree (lb)	Drops (lb/tree)	Picks (lb/tree)	1999 Yield (lb/tree)	Average Fruit Wt (oz)	Mean Pressure of Blush & Offsides (lb)	Percent Soluble Solids	Trunk Circumference (in.)	Percent of Trees Alive	Number of Suckers
M.26 EMLA	470	18	68	79	5.4	20.4	14.0	15.6	53.3	0.7
M.9 EMLA	419	15	62	68	4.7	22.1	13.0	13.0	41.7	5.4
Ottawa 3	353	7	53	77	5.5	18.9	12.7	12.6	16.7	7.7
Bud.9	309	18	35	51	5.1	21.5	13.7	9.8	82.6	5.8
MARK	190	11	20	40	4.0	21.0	13.3	7.6	46.7	3.5
P.22	172	13	20	51	4.6	21.3	13.5	6.9	46.7	3.5
Mean	313	15	40	53	4.8	21.1	13.5	10.7	47.8	3.9
LSD (.05)	99	4	20	23	0.6	0.9	1.1	2.3	N/A	3.9

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] Arranged by cumulative yield in descending order.

II. 1993 CG-Liberty Apple Rootstock Planting

This planting is located on a farm of a commercial apple producer in Nancy, KY, which is about 200 miles east of Princeton. The planting provides us with a comparison of rootstock performance between Western and south-central Kentucky. To date, differences in mortality have not been statistically significant. Three out of eight trees on CG.202 and CG.210 have died, and four trees on CG.30, CG-222, and CG-13 and two on M.7 have died. Statistical differences were not observed for trunk circumference, the number of root suckers, theoretical cumulative, and 1999 yield (Table 4).

III. 1994 Apple Semi-dwarf Rootstock Planting

The 1994 semi-dwarf apple rootstock planting is the first trial at this station to be trained to the French vertical axe system. It also includes a number of new stocks, along with some that have performed well in previous plantings at UK REC.

This planting was established as planned, except for the substitution of B.9 for P.1. Trickle irrigation and a trellis system similar to the one in the 1990 apple planting were constructed in 1995. The mortality of trees on M.26 (10% survival) differed significantly from trees on the other five rootstocks (100% survival for trees on CG.11 and 90% for the others). The maturity indices (% soluble solids and pressures), the weight of picked and dropped fruit, cumulative yield, 1999 yield, trunk circumference, and the number of root suckers varied significantly by rootstock (Table 5).

IV. 1999 Dwarf and Semi-dwarf Apple Rootstock Plantings

This planting 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 rootstocks and three of the semi-dwarfing ones have not been tested at the Princeton station.

Ninety trees of a possible 108 are in our planting because 12 were not available for our site (one CG.16N, two-CG.13, three CG.41, one CG.814, and four CG.30N). Furthermore, three trees never leafed out after planting (one CG.16T, one CG.16N, and one CG.41N). In spite of the severe drought, all the others appear to be alive.

Significant differences were observed for trunk circumference in the spring and fall for both groups of rootstocks (Table 6). Significant differences were observed for growth in trunk circumference for the semi-dwarfing rootstocks but not for the dwarfing ones. Conversely, the number of feathers varied significantly for the dwarfing rootstocks but not the semi-dwarfing ones.

V. 1990 Stanley Plum Rootstock Planting

Poorly drained clay soils typically found in Kentucky have limited plum production. Rootstocks recently developed in France on soils similar to ours offer the potential for expanding the fruit industry in Kentucky to include this crop.

To date, three trees on Julian A, five on Citation rootstock, two trees on Myrobolan seedling, and one tree of Marianna GF 8-1 have died, probably as a result of winter injury. All others

Table 3. 1999 results NC-140 1990 apple cultivar/rootstock planting[1].

Cultivar/Rootstock Combination[2]	Dropped Fruit/ Live Tree (lb)	Average Fruit Wt (oz)	Fruit Pressure (lb)
Liberty/M.26	20	3.4	23.0
Liberty/M.9	18	4.3	23.1
Golden Delicious/M.26	9	6.2	17.9
Rome/M.26	29	7.1	21.4
Jonagold/M.26	20	7.2	15.9
Empire/M.26	13	4.0	21.0
Liberty/Bud.9	22	3.5	23.2
Golden Delicious/Bud.9	13	5.5	18.2
Jonagold/Ottawa 3	9	6.6	17.4
Rome/M.9	18	7.6	21.9
Rome/Bud.9	26	7.9	23.3
Empire/Ottawa 3	4	3.4	21.8
Empire/M.9	11	4.3	21.2
Empire/Bud.9	7	4.0	21.5
Jonagold/P.22	9	7.1	14.5
Golden Delicious/MARK	9	3.6	22.2
Liberty/MARK	24	2.8	23.3
Liberty/P. 22	22	4.1	22.7
Empire/MARK	7	4.4	21.3
Rome/MARK	7	•	•
Rome/P. 22	18	7.5	19.6
Jonagold/MARK	13	5.1	15.6
Empire/P.22	4	4.1	21.8
LSD (0.5)	11	1.4	21.1

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] Arranged by cumulative yield in descending order.

Table 4. 1999 results 1993 NC-140 CG-Liberty apple rootstock planting[1].

Rootstock[2]	Theoretical Cumulative Yields[3] (lb/tree)	1999 Yield (lb/tree)	1999 Trunk Circumference (in.)	Number of Root Suckers[4]
CG.030	254	126	12.7	1
CG.210	225	137	14.3	1
CG.222	223	121	12.2	5
CG.202	139	37	9.0	1
M.7	130	53	12.1	2
CG.013	121	90	12.4	9
Mean	181	9	12.0	3
LSD (.05)	161	86	3.9	9

[1] Appledale Farm, Nancy, KY.
[2] Arranged by theoretical cumulative yield in descending order.
[3] Theoretical cumulative yield was calculated by summing the theoretical yield for 1996 through1999. Theoretical yield for 1996 through 1997 was calculated by multiplying the number of fruit on each live tree in this planting by the average weight/fruit from 'Liberty' trees in the 1990 apple planting (4.4 oz and 4.3 oz for 1996 and 1997, respectively). For 1998 and 1999, yield to the nearest 0.1 bushels was converted to pounds by using a conversion factor of 42 lb/bushel.
[4] Suckers are a disadvantage because they serve as a source of infestation and must be removed.

(86%) are alive. Statistical differences were observed for cumulative yield, 1999 yield, picked and dropped fruit, fruit size, number of root suckers, and trunk circumference, but not for soluble solids (Table 7).

VI. 1994 Peach Rootstock Planting

Peaches are one of the most popular fruits in Kentucky. The strong market for this crop continues to entice growers to plant trees in spite of the fact that one can expect erratic production due to extreme temperature fluctuations that occur in winter and spring in this state. A rootstock that is more suitable to Kentucky's climate than ones traditionally used would be of great value to fruit industry in the state. A rootstock that could significantly delay bloom would change the future of the Kentucky peach industry. To date, 75 of the 94 trees planted are alive (80% survival). Statistical differences were observed for trunk circumference, 1999 yield, and average fruit weight (Table 8), but differences were not observed for cumulative yield, bloom date, number of root suckers, fruit pressure, and soluble solids (Table 7). The Julian date for 10% maturity was 183 for all trees, except for those on Ta Tao, which was 193.

The NC-140 plantings are of utmost importance to Kentucky for gaining access to and testing new rootstocks from around the world. The detailed and objective evaluation of these rootstocks will provide growers with the information needed to select the most appropriate rootstocks for their needs when they become commercially available in the future.

The 1990 Apple Cultivar/Rootstock Planting and the 1994 and 1999 Apple Rootstock Planting will provide us with needed information on adaptability of the slender spindle and the vertical axe systems to trees grown on our fertile soils. The 1993 CG-Liberty Apple Planting is an off-station cooperative effort between the University of Kentucky and a commercial grower and provides us with a way to compare rootstock performance between Western and south-central Kentucky. The 1990 Plum Planting should provide us with needed information to determine if there are suitable rootstocks for growing plums in western Kentucky's wet clay soils. The 1994 Peach Planting should provide us with needed information to determine if tree survival, winter hardiness, and cropping frequency can be improved by using any of the recently developed rootstocks.

The NC-140 orchard systems plantings are regularly used as demonstration plots for visiting fruit growers, Extension personnel, and research scientists. The research data collected in these trials will help to establish baseline production and economic records for the various orchard system/rootstock combinations which can be utilized by orchardists in Kentucky.

Literature Cited

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Table 5. 1999 results NC-140 1994 apple semi-dwarf rootstock planting[1].

Rootstock[2]	Cumulative Yield/ Live Tree (lb)	Picks (lb/tree)	Drops (lb/tree)	1999 Yield (lb/tree)	Fruit Size (oz/fruit)	Mean Pressure of Blush & Off sides (lb)	Percent Soluble Solids	Truck Circum. (in.)	Number of Root Suckers
CG.30	251	123	13	137	4.8	20.4	13.6	9.2	23
V.2	229	101	9	110	4.7	19.4	13.3	8.8	8
M.26 EMLA	212	68	4	73	4.2	23.4	13.9	7.7	0
B.9	121	46	7	53	4.0	20.0	13.2	5.7	2
CG.11	106	73	7	79	4.7	17.9	13.9	13.5	18
CG.13	101	73	4	79	5.1	19.4	14.6	14.1	20
Mean	159	84	9	90	5.7	19.5	13.7	10.3	14
LSD (.05)	53	29	7	29	0.6	2.0	1.0	1.4	15

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] Arranged by cumulative yield in descending order. There is usually a direct correlation between trunk circumference and yield.

Table 6. 1999 results NC-140 1999 apple dwarf and semi-dwarf rootstock planting[1].

Rootstock	Trunk Circumference (in.)		Trunk Circumference Growth (in.)	Number of Feathers	Number of Trees Planted	Number of Trees Lost[3]
	Mar 99	Oct 99				
Dwarfing[2]						
CG.13	3.0	3.1	0.1	16	4	0
G.16N	2.0	2.2	0.2	8	5	1
G.16T	2.0	2.3	0.3	7	6	1
CG.41	2.0	2.3	0.3	10	3	1
Sup.1	2.0	2.2	0.2	5	6	0
Sup.3	2.0	2.2	0.2	6	6	0
CG.179	1.9	2.1	0.2	8	6	0
Sup.2	1.9	2.1	0.2	4	6	0
CG.202	1.9	2.0	0.2	8	5	0
M.9	1.6	1.7	0.1	2	6	0
M.26	1.5	1.7	0.2	3	6	0
Mean	1.9	2.1	0.2	6	—	—
LSD (0.05)	1.6	1.6	0.2	4	—	—
Semi-Dwarfing[2]						
CG.30N	2.4	2.7	0.3	6	2	0
Sup.4	2.4	2.4	0.1	5	6	0
M.7	1.9	2.0	0.2	4	6	0
CG.707	1.7	1.8	0.1	4	5	0
CG.814	1.6	1.8	0.2	4	5	0
M.26	1.5	1.8	0.3	2	6	0
Mean	1.9	2.0	0.2	4	—	—
LSD (0.05)	2.4	0.3	0.2	4	—	—

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] Arranged by size of trunk circumference at planting in descending order.
[3] These trees never leafed out after planting (1st week in March, 1999).

Table 7. 1999 results NC-140 1990 plum planting[1].

Rootstock[2]	Cumulative Yield/Live Tree (lb)	Picks (lb/tree)	Drops (lb/tree)	1999 Yield (lb/tree)	Average Fruit Wt (oz)	Number of Root Suckers	Trunk Circumference (in.)
Marianna 4001	384	201	8.8	209	1.4	18	17.9
Marianna GF-8-1	357	181	11.0	191	1.5	91	18.3
Myrobolan 29C	306	154	6.6	152	1.8	27	18.5
GF 31	333	146	8.8	154	1.4	9	15.8
Lovell Sdlg.	333	126	6.6	134	1.7	2	16.3
St. Julian A	322	130	4.4	134	1.6	11	15.3
EMLA Pixie	317	137	4.4	141	1.4	27	16.5
Myrobolan Sdlg.	340	154	4.4	159	1.4	53	15.7
Brompton	205	77	8.8	86	1.3	14	11.7
Citation	159	35	15.4	51	1.1	2	10.0
Mean	317	141	8.8	148	1.5	27	16.1
LSD (0.05)	73	40	4.4	40	0.3	21	1.9

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] Arranged by cumulative yield in descending order.

Table 8. 1999 results 1994 NC-140 peach rootstock planting[1].

Rootstock[2]	Cumulative Yield/Live Tree (lb)	1999 Yield (lb/tree)	Trunk Circumference Spring (in.)	Average Fruit Wt (oz)	90% Julian Bloom Date
Lovell	276	49	16.3	8.6	95.0
Ta Tao 5	234	88	13.2	6.8	96.3
CF 305	218	84	15.4	8.3	94.5
Montclar	212	64	15.8	7.9	95.1
BY 520-9	205	57	15.5	8.5	94.4
Stark's Redleaf	203	37	15.6	9.2	95.0
Ishtara	196	110	11.6	5.6	93.6
BY 520-8	194	44	15.4	8.9	95.0
Rubira	194	84	15.0	7.9	95.0
Bailey	192	53	13.3	8.2	94.5
Tenn Natural	185	53	13.7	8.5	94.5
Higama	172	40	14.1	8.6	95.0
Mean	205	64	14.6	8.1	94.8
LSD (.05)	53	40	1.3	1.2	1.3

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] Arranged by cumulative yield in descending order.

Optimal Training of Apple Trees for High Density Plantings

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Introduction

Early production and optimal fruit size on vigorous sites are obtained when photosynthates are balanced properly between flower bud initiation and vegetative growth. Kentucky growers often have a problem with excessive vegetative growth or vigor, which greatly reduces the production that can be achieved from high density apple plantings. Pruning and training are possibly the most important techniques used by fruit 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. Both the University of Kentucky College of Agriculture and the Kentucky State Horticultural Society have made a long-term commitment to help meet this need. For this reason, research was initiated to determine training and pruning practices needed to obtain early production and optimal fruit size from trees trained to either the slender spindle or the French axe system on vigorous sites.

Materials and Methods

One hundred eighty trees of Golden Delicious on M.9 rootstock were set out in May 1997 in a randomized complete block design with eight treatment combinations (five rows with 32 trees/row). Trunk circumference averaged 2.4 in. at planting and did not vary significantly among rootstocks. A trellis was constructed, and trickle irrigation was installed. The trees were trained according to the treatment protocol (Table 1). Tree spacing was 8 ft apart within rows 16 ft 5 in. apart. Soil management was a 6.5 ft herbicide strip with mowed sod alleyways. Trees were fertilized and sprayed according to local recommendations (1, 2). Yield (beginning with 1998 yield), trunk circumference, and maturity indices such as soluble solids and flesh pressure were measured annually.

Table 1. UKREC 1997 apple training study pruning/training treatments.

System	Pruning Level	Pruning Interval in Wks	Amount of 1-Year-old Wood Left after Heading at Planting	Angle[1]	Limbs[2]	Leader[3]
French Axe	Light	1	Not headed	45	No	D
French Axe	Moderate	2	12-16 in.	45-60	Yes	C&D
French Axe	Moderate	1	12-16 in.	45-60	Yes	D
French Axe	Heavy	1	8-12 in.	60-90	Yes	D
Slender Spindle	Light	1	Not headed	45	No	A
Slender Spindle	Moderate	2	14-20 in.	45-60	Yes	B
Slender Spindle	Moderate	1	14-20 in.	45-60	Yes	B
Slender Spindle	Heavy	1	10-14 in.	60-80	Yes	C

[1] Angle limbs are to be positioned.
[2] French Axe—completely remove overly vigorous branches with narrow angles when 3 to 6 inches long. Slender Spindle—completely remove branches that compete with leader.
[3] Leader management for 1999: A = weak leader renewal and new leader headed at 12 inches. B = bend leader at 60° angle, alternating direction with every 18 inches 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

Table 2. 1999 training results KSHS-1998 apple training planting[1].

Pruning Level[2]—Interval in Wks	Trunk Circumference (in.)	Yield[3]/Tree (lb) Cumulative	Yield[3]/Tree (lb) 1999	Average Fruit Wt (oz)	Minutes/10 trees 1997[4]	Minutes/10 trees 1998[5]	Minutes/10 trees 1999[6]	Total Time	Minutes/Lb of Fruit
Light–1	5.2	21.2	19.8	6.2	122	102	182	406	19.2
Moderate–2	5.3	24.0	22.0	6.2	96	86	165	347	14.5
Moderate–1	5.5	19.8	17.1	5.9	114	111	191	416	21.0
Heavy–1	5.2	20.9	20.5	6.1	119	120	216	455	21.8
Mean	5.3	21.4	19.8	6.1	113	103	189	405	18.9
LSD (0.05)	0.5	4.9	4.9	0.5	NA	NA	NA	NA	NA

[1] University of Kentucky, Research and Education Center, Princeton, KY.
[2] As described in Table 1.
[3] Yield is the sum of picked and dropped fruit. Dropped fruit averaged less than 2.2 lb/tree.
[4] For 14 weeks.
[5] For 12 weeks.
[6] For 16 weeks.

Results and Discussion

Trunk circumference, yield, and average weight/fruit did not vary significantly in the analysis of variance (Table 2). All trees are currently alive. Over half the total time spent training the trees was spent during the first five weeks the trees were trained. About two minutes/week was needed to train each tree during the first five weeks, but only 45 seconds/week was needed in the sixth week through the 16th week.

This and other plantings are regularly used as demonstration plots for visiting apple growers, Extension personnel, and research scientists. The research data collected in these trials will help to establish baseline production methods and an economic basis for the various orchard system/rootstock combinations that can be later used by orchardists in Kentucky.

Literature Cited

1. G.R. Brown, R.T. Jones, J.G. Strang, L.A. Lester, J.R.Hartman, D.E. Hershman, R.T. Bessin. 1998 Commercial Tree Fruit Spray Guide. University of Kentucky, College of Agriculture Cooperative Extension Service, publication ID-98.

2. Midwest Tree Fruit Handbook, University of Kentucky, College of Agriculture Cooperative Extension Service, publication ID-93.

Blueberry Cultivar Trial

Dwight Wolfe and Gerald R. Brown, Department of Horticulture

Introduction

The blueberry is a fruit crop that is native to North America. At present, Kentucky has a small established commercial blueberry market and an excellent potential for local sales, U-pick, and home use.

Materials and Methods

A blueberry cultivar trial was established in the spring of 1993 at the UK College of Agriculture Research and Education Center in Princeton. The planting consists of eight cultivars spaced 4 ft apart within rows spaced 14 ft apart. The pH was reduced from above 6 to 5.4 with elemental sulfur prior to planting. The planting is mulched yearly with sawdust and is trickle irrigated using 1 gph vortex emitters. The planting is netted during 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 1999, the 1999 yield, and average percent fruit ripe by the end of the second and fourth weeks of June are shown in Table 1. Duke and Sierra have produced the most fruit to date. Duke has also been the earliest ripening cultivar in our planting, with 14.3% of Duke's fruit ripening during the first week of June. Sunrise also ripens early, with 7.7% of its fruit ripening during the first week of June. Picking for the other cultivars begins during the second week of June and is pretty well finished for all cultivars by the end of the fourth week of June. An exception would be Nelson, which is picked through the first week of July.

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.

Other factors important to cultivar selection are discussed in other publications (1,2).

Literature Cited

1. John Strang, Terry R. Jones, and G.R. Brown. 1989. Growing Highbush Blueberries in Kentucky. University of Kentucky College of Agriculture Cooperative Extension Service, publication HO-60.

2. Dwight Wolfe and Gerald R. Brown. 1999. Blueberry Cultivar Trial. Kentucky Fruit Facts. 1-99:2.

Table 1. Blueberry cultivar trial results[1].

	Yield (lb/bush)		Average Percent Ripe Fruit at End of Week in June	
Cultivar[2]	Cumulative	1999	2nd	4th
Duke	32.4	9.3	55.1	93.7
Sierra	28.9	7.8	32.2	90.9
Bluecrop	24.7	6.7	28.7	79.1
Blue Gold	24.5	8.8	32.9	78.2
Toro	23.6	6.2	27.1	76.2
Nelson	22.3	5.9	14.6	66.7
Sunrise	17.8	5.7	53.0	95.2
Patriot	16.2	5.4	47.4	93.8
LSD (0.05)	4.2	1.9	5.4	2.4

[1] The planting was established in April 1993. Plant spacing is 4 feet between bushes in rows 14 feet apart. There are three bushes/cultivar/rep combination.
[2] In descending order of cumulative yield (1995-1999).

Spring Fresh Market/Slaw Cabbage Cultivar Evaluation in Eastern Kentucky

Terry Jones, Department of Horticulture

Kentucky growers produce an estimated 700 acres of spring cabbage for sale to fresh and slaw markets. Bravo has been the standard cultivar grown for both markets. It has excellent hardiness and disease resistance. It produces a head that is large (4-6 lb), and close plant spacing must be practiced to permit sales to fresh market. Some buyers also complain about poor head density. Buyers would like to be able to buy a dense cabbage from Kentucky 10 to 14 days earlier than our current harvest in order to fill a market window that exists between the end of harvest in Georgia and the onset of Kentucky sales. Seventeen cabbage cultivars were evaluated for spring production at Quicksand in 1999.

Materials and Methods

Seventeen cabbage cultivars were seeded on 3/28/99 in the greenhouse. They were transplanted to the field on 4/22/99 at Quicksand. The plot consisted of a randomized complete block design with four replications. Each replication was a single row 15 ft long. Plant spacing in row was 12 in., and rows were 36 in. apart. Fifteen plants/replication for each cultivar were used. One cup/plant of a 20-20-20 starter fertilizer was used at transplanting. Soil test results for this site are shown below.

Table 1. Cabbage trial 1999 fresh market cabbage soil test results*.

pH	Buf pH	P	K	Ca	Mg	Zn
6.7	7.2	119	252	5151	217	9.5

* Soil test results from 1998.

On 28 April, six days after transplanting, Devrinol 50 WP (4 lb) was applied over the top of the cabbage plants and irrigated in for weed control. Cabbage was fertilized three times (May 3, May 17, and May 31) by side dressing 50 lb actual N/acre as ammonium nitrate (NH_4NO_3). This represents a total of 150 lb actual N/acre and is close to what is recommended in *Commercial Vegetable Crop Recommendations 1998-99* (ID-36). Plots were sprayed as needed for insect and disease control. Overhead irrigation was used to maintain plant growth and head formation.

Results and Discussion

The 1999 cabbage growing season was warm and dry throughout. Because of irrigation, plant size and yield were much higher than most commercial growers experienced. Results for the 17 cabbage cultivars are shown in Tables 2 and 3. Sixteen of the 17 cultivars showed no significant difference in head numbers/acre; only Cecile had significantly fewer heads/acre. When total pounds of cabbage/acre was evaluated, Bravo and Fresco produced significantly more pounds of cabbage than the other cultivars. Nine other cultivars that were not different significantly from each other and produced good yields were Histonia, Blue Vantage, Atlantis, Blue Dynasty, Regalia, Bronco, XPH 15701, Ramada, and Morris. Average head weight was significantly higher for Bravo and Fresco. The following cultivars produced good head size and were not significantly different from each other: Blue Dynasty, Blue Vantage, Histona, Atlantis, Morris, Bronco, Regalia, Ramada, and XPH 15701. Comparing head density, the following seven varieties were the most dense and did not differ significantly: Ramada, Dynamo, Azurro, Super Red 80, Cecile, Blue Vantage, and Bronco.

Boxed cabbage requires a count of 14 to 16 heads that weigh slightly more than 50 pounds. The following cultivars fit these requirements: Super Red 80, Cecile, Gideon, Heads Up, and Azurro. Two of these are red cultivars, and the other three are green cultivars. Cecile had plant stand problems (unidentified root rot), and Heads Up had a big core and was slightly loose. It also had wide leaves at the base of the heads that held water. Gideon was still the best box-sized cabbage tested this year. Gideon did not do as well in this year's trial as in past years. Average head size was smaller (3.9 lb vs. 4.1 lb in 1998); yield/acre was also several thousand pounds less. For growers without water, Gideon tended to be smaller than marketable size. Some growers reported more thrips damage on Gideon than on other nearby cultivars.

The three green cabbage cultivars that were among the highest scoring in the first three criteria were Ramada, Blue Vantage, and Bronco. Bronco and Ramada held their heads up off the ground and had narrow wrapper leaf bases, which reduced head decay. Bravo, the industry standard for fresh green cabbage, produced the most lb/acre and had the largest head size (6.8 lb) among all cultivars tested. Bravo, however, has a fairly loose head and is not suitable for boxed cabbage under good growing conditions and 12 inch, in-row spacings. Bronco and Ramada held their heads up off the ground and had narrow wrapper leaf bases which reduced head decay. Bravo, the industry standard for fresh green cabbage, produced the most lb/acre and had the largest head size (6.8 lb) among all cultivars tested. Bravo, however, has a fairly loose head and is not suitable for boxed cabbage under good growing conditions and 12-inch, in-row spacings.

Table 2. Cabbage yields and quality measurements, Quicksand, KY.
Yield data are means of four replications.

Cultivar	Days to Harv	Head No./acre	Total Wt Lb/Acre	Avg Wt/Hd (lb)	Core Size (in.)	Head Dim. LxW (in.)	Hd Density[1]		Head Shape[2]	Internal Color[3]	Wt Crate 14 Hd (lb)	Plant Size[4]
							PSI	Rated 1-5				
XPH 15701	70.0	14278	62,620	4.4	3.7	6.8 x 6.5	21.5	4	2	2	61.3	2
	Blue green cabbage, big core, leaves wide at base, hold water.											
Blue Dynasty	76.5	12826	66,066	5.1	3.3	7.5 x7.0	22.0	5	2	5	72.0	3
	Attractive plant, leaves wide at base. Some heads not very solid.											
Morris	71.0	13068	61,468	4.7	3.2	6.9 x 6.7	22.7	5	2	5 - 2	66.0	2.5
	Blue-green cabbage, wide leaves at base, uneven head size, hot taste.											
Super Red 80	84.0	13068	47558	3.7	3.8	6.7 x 6.1	27.7	5	3	6	51.1	2.3
	Solid, hard heads, narrow leaves at base, some heads failed to size up.											
Blue Vantage	76.0	14036	71,816	5.1	3.8	7.6 x 6.9	27.2	5	2	1 - 2	71.5	3
	Big core, nice-looking but actually loose inside heads. Leaves wide at base, hold water.											
Dynamo	65.0	13068	25,952	2.0	2.1	5.5 x 4.9	27.9	5	2	5	27.8	1.3
	Nice early home garden cv. type. Blue-green heads. Very uniform. Good taste.											
Ramada	81.0	18392	64,691	4.6	3.2	6.8 x 6.2	28.7	5	2	1	63.7	2.8
	Attractive, and heads hold up well. Leaves narrow at base, solid heads. Some size variability due to crowding.											
Cecile	74.0	11132	45,012	4.0	2.9	6.7 x 5.3	27.6	5	2	1	55.5	3
	Variable plant and head size. Some stunted plants never harvested because of root disease. Leaves wide at base, hold water.											
LSD (P=0.05)		1475	12468	0.8			2.3					

[1] PSI: pounds/square in. measured with a penetrometer. Also rated 1-5 with 1= very loose and 5= very hard.
[2] Head shape: 1 = flat, 2 = round, 3 = high round.
[3] Internal color: 1 = white, 2 = whitish green, 3. = yellowish green, 4 = yellow, 5 = whitish yellow, 6 = red and white.
[4] Plant size: 1 = small, 2 = medium, 3 = large.

Table 3. Cabbage yields and quality measurements, Quicksand, KY.
Yield data are means of four replications.

Cultivar	Days to Harv	Head No./acre	Total Wt Lb/Acre	Avg Wt/Hd (lb)	Core Size (in.)	Head Dim. LxW (in.)	Hd Density[1]		Head Shape[2]	Internal Color[3]	Wt Crate 14 Hd (lb)	Plant Size[4]
							PSI	Rated 1-5				
Bravo	84.0	13,794	94,380	6.9	3.7	7.2 x 8.0	21.0	4	1 - 2	1	95.8	3
	Healthy plants. Fairly big core. Leaves wide at base Blue-green heads not very solid.											
Fresco	82.0	14,278	94,380	6.6	3.9	8.4 x 7.6	20.4	5	2	1	92.7	3
	Brownish-watery core when cut. Did not taste good. Leaves wide at base and hold water, some trimming necessary.											
Atlantis	74.0	13,310	66,676	5.0	2.9	7.4 x 6.6	21.7	5	2	1	70.4	2
	Some uneven plant and head sizes. Leaves narrow at base. Some sunburn on heads.											
Gideon	76.0	13,310	51,672	3.9	3.8	7.1 x 5.9	24.2	5	3	1	54.3	2.6
	Wavy leaf margins. Narrow leaves at base, head held up off ground well. Very solid heads.											
Histona	71.0	14,278	72,416	5.1	3.3	7.5 x 7.0	23.6	5	2	5	71.0	3
	Blue-green cabbage with wide leaves at base. Uneven head size, big core. Good taste.											
Heads Up	64.5	14,036	56,686	4.0	4.2	7.3 x 6.9	21.9	4	2	2	56.5	2.4
	Big core for size. Somewhat loose with air space in heads, leaves wide at base.											
Regalia	70.0	14,278	65,398	4.6	3.4	7.4 x 6.7	16.9	3	2	2	64.1	2
	Wide leaves at base hold water. Not very solid.											
Bronco	75.0	13,794	63,704	4.6	3.4	7.4 x 6.7	25.8	5	3	2 - 5	64.6	3
	Heads up off ground, leaves narrow at base, very solid, some uneven plant size. Crowded. Nice heads!											
Azurro	77.0	12,826	51,672	4.0	3.4	6.8 x 6.2	27.9	5	3	6	56.3	2.6
	Nice plant, heads up off ground, leaves narrow at base, Heads larger on ends of plots. Did not like chewy taste.											
LSD (P=0.05)		1,475	12,468.0	0.8			2.3					

[1] PSI: pounds/square in. measured with a penetrometer. Also rated 1-5 with 1= very loose and 5= very hard.
[2] Head shape: 1=flat, 2=round, 3=high round.
[3] Internal color: 1=white, 2=whitish green, 3=yellowish green, 4=yellow, 5=whitish yellow, 6=red and white.
[4] Plant size: 1=small, 2=medium, 3=large.

Spring Fresh Market/Slaw Cabbage Evaluation in Central Kentucky

John Strang, Kay Oakley, Dave Lowry, Darrell Slone, and John Snyder, Department of Horticulture
Angelika Parham, Louie Hodge, and Young Wilbur, Bud's Produce, Elizabethtown, KY

Introduction

'Bravo' has been the standard cabbage variety grown in Kentucky for both fresh and processing markets for many years. This variety has very good disease resistance and has been a dependable producer in difficult seasons such as we experienced in 1999. A market window exists for Kentucky cabbage, which is 10 to 14 days earlier than 'Bravo.' Consequently, this study was initiated to evaluate a number of the newer cabbage varieties at the University of Kentucky South Farm in Lexington.

Materials and Methods

Seventeen cabbage cultivars were planted on March 28 in the greenhouse. Transplants were set on May 4 in a randomized complete block design with four replications. Plots were 15 ft long, and plants were set in double rows with plants spaced 13 in. apart in the row and 15 in. between rows on 4 ft centers. There were 30 plants/plot. A 20-20-20 starter solution was used at transplanting. Preplant fertilizer consisted of 140 lb of actual N, P, and K/acre as 19-19-19. Plants were fertigated with 99 lb of actual N as ammonium nitrate on June 18. Dual Magnum at 2 pts/acre was applied on May 3 for weed control. Pounce, Sevin, Asana, and Dipel were used for insect control, while Bravo, fixed copper, and Dithane M45 were used for disease control. The plot was trickle irrigated based on soil tensiometer readings. Ten ft of row were harvested in each plot on June 29 and on July 2, 6, 8, 12, 15, and 19. Five heads of each cultivar were taken to Bud's Produce in Elizabethtown on June 28 and evaluated for slaw acceptability and shelf life.

Results and Discussion

The season was hot and dry, particularly toward the end of harvesting. The top earliest maturing fresh market cultivars (57 to 70 days after transplanting) were Ramada, Fresco, Atlantis, and Blue Vantage. Although Ramada is listed in catalogues as being a later-maturing variety, it matured relatively early in these trials. The top later-maturing fresh market cultivars (70 or more days after transplanting) were Bravo, Bronco, Cecile, and Blue Dynasty. Ramada, Blue Dynasty, and Atlantis should be spaced slightly farther apart in the row to increase head size.

From a processing standpoint, the best early slaw varieties were Heads Up and Ramada. Blue Vantage was the best in last year's trials but did not hold up well this year after processing. The best later-maturing slaw variety was Cecile. All of these were judged to be exceptionally good at holding up after processing, as slaw made from them stored for 18 days, fully a week longer than the normal expected shelf life.

The red cabbage cultivar Super Red 80 performed slightly better than Azurro.

Table 1. Cabbage yield and head characteristics, Lexington, KY.
Yield data are means of four replications.

Cultivar	Seed Source	Days to Harvest	Total Yield (lb/acre)	No. Heads /Acre	Head Wt (lb)[z]	Core Length (in)[y]	Head Size L x W (in)[y]	Head Density (psi)[x]	Head Density (1-5)[yw]
Bravo	H	73	81,757	19,602	4.2	2.9	17.5 x 23.4	15.8	2.6
Fresco	SW, BZ	60-70	69,097	18,241	3.8	3.0	20.4 x 21.5	14.8	2.6
Bronco	SW, BZ	70	62,699	18,513	3.4	2.8	19.1 x 19.4	21.3	3.4
Cecile	SW, BE	70	61,338	18,241	3.4	2.4	18.9 x 19.0	22.7	3.4
Histonia	SW,BZ	57-60	60,984	19,058	3.2	2.2	18.9 x 19.9	15.6	2.3
Heads Up	H	57-60	58,942	19,058	3.1	3.3	18.8 x 19.6	18.3	3.6
Blue Vantage	ST	60	58,534	18,241	3.2	2.3	19.1 x 19.4	20.2	2.4
XPH15701	AS,PS	57-60	57,663	17,969	3.2	2.5	18.1 x 19.6	16.8	3.4
Ramada	SW,BZ	64-70	57,036	19,602	2.9	2.9	17.6 x 19.1	23.8	3.5
Blue Dynasty	AS,PS	70-73	56,265	19,239	2.9	2.7	17.7 x 18.8	19.6	2.7
Regalia	ST	57	54,995	18,785	2.9	2.3	19.0 x 17.9	14.6	3.9
Atlantis	ST	57-60	54,042	19,330	2.8	2.0	18.4 x 18.0	18.0	3.6
Morris	SW,BZ	57-60	53,906	19,330	2.8	2.1	17.8 x 18.6	17.8	3.5
Gideon	SW,BZ	70	51,183	17,969	2.8	3.3	18.0 x 18.4	22.4	3.6
Super Red 80	LI	70	50,530	19,058	2.7	2.8	16.1 x 16.3	23.1	3.9
Azurro	SW,BZ	70	43,016	18,513	2.3	3.6	16.5 x 17.9	23.7	2.1
Dynamo	H	57	27,524	19,058	1.4	1.4	14.9 x 14.2	23.5	4.5
Waller-Duncan									
LSD (P = 0.05)			7,225	ns	0.5	1.1		3.1	0.8

[z] Based on 12 heads.
[y] Based on 12 heads.
[x] psi = pounds/square inch. Measured with a penetrometer (5/16 in. diam. head); avg for 12 heads.
[w] Rated as 1 = very loose to 5 = very hard.

Table 2. Cabbage head characteristics and fresh market quality, Lexington, KY.

Cultivar	Head Shape (1-3)[z]	Internal Color (1-4)[y]	Head Cracking (1-5)[x]	Wrapper Leaf Coverage (1-5)[w]	Leaf Drainage (1-5)[v]	Number of Off Type, Soft Head, or No Head	Wt of 16 Heads (lb)	Fresh Market Quality (1-5)[u]
Bravo	1	3	1.0	4.3	2.8	0.00	67	4.5
Fresco	2	3	1.3	2.8	3.6	0.00	61	3.8
Bron	2	3	1.0	3.9	3.8	0.00	54	5.0
Cecile	2	3	1.0	3.6	3.3	0.50	54	3.8
Histonia	2	3	1.5	1.6	2.0	0.25	51	2.3
Heads Up	2	3	4.8	1.5	2.0	0.00	50	2.0
Blue Vantage	2	3	1.0	3.1	3.0	0.75	51	4.5
XPH15701	2	3	3.5	2.3	2.5	0.25	51	3.3
Ramada	2	2	1.0	4.4	3.5	0.50	46	4.5
Blue Dynasty	2	3	1.6	4.4	3.6	0.25	46	4.5
Regalia	2	3	4.8	1.9	2.0	0.00	46	2.0
Atlantis	2	3	1.5	2.8	3.3	0.25	45	3.8
Morris	2	3	1.3	1.9	1.8	0.00	45	2.8
Gideon	2	3	1.0	4.6	4.5	0.75	45	4.8
Super Red 80	2	5	1.0	4.3	3.9	0.25	43	4.0
Azurro	1	5	1.0	5.0	2.8	0.75	37	4.3
Dynamo	2	3	1.0	2.0	2.3	0.00	22	2.0
Waller-Duncan								
LSD (P-0.05)	0		1.8	1.8	1.3			0.5

[z] Rated as 1 = flat, 2 = round, 3 = pointed.
[y] Rated as 1 = white, 2 = whitish green, 3 = yellowish green, 4= yellow.
[x] Rated on 8/8/99 from heads remaining in the field 20 days after harvest was completed.
[w] Rated as 1 = poor to 5 = excellent.
[v] Rated as 1 = poor to 5 = excellent water drainage from the base of the head.
[u] Rated as 1 = poor to 5 = excellent external visual evaluation.

Table 3. Processing quality for fresh market/slaw cabbage and comments, Lexington, KY.

Cultivar	Start of Test[z] Processing Quality (1-5)[y]	Start of Test[z] Processing Firmness (1-5)	Day 6 Processing Quality[x] (1-5)	Day 11 Processing Quality[x] (1-5)	Day 17 Processing Quality[x] (1-5)	Day 21 Processing Quality[x] (1-5)	Comments on Appearance and Taste
Bravo	2	2	4	4	4	4	Fairly uniform shape and size; knots on top; sweet, tender, juicy, spicy aftertaste.
Fresco	2	2	2	3	4	4	Uniform size; sweet, mild, crunchy, tender.
Bronco	2	2	4	4	4	4	Uniform size; very sweet, crunchy, juicy, spicy aftertaste.
Cecile	2	2	2	2	2	4	Fairly uniform size; solid attractive interior; very crunchy, juicy, sweet, slightly spicy.
Histonia	2	2	2	3	4	4	Large uniform attractive head; uniform size; some surface splitting of outer leaves; taste dry, mild, crisp.
Heads Up	2	2	1	1	1	4	Attractive; uniform size; internally not solid; taste crunchy, mild, dry.
Blue Vantage	2	2	4	4	4	4	Fairly uniform and attractive; very juicy, sweet to spicy, crisp.
XPH15701	2	2	4	4	4	4	Attractive; uniform size; nice flavor; crisp, juicy, tender, slightly spicy; some leaf checking late in season.
Ramada	2	2	1	1	1	4	Uniform size and shape, taste sweet, crunchy.
Blue Dynasty	2	2	4	4	4	4	Uniform size; taste crunchy, very sweet, dry.
Regalia	2	2	2	3	4	4	Uniform size; internally attractive; some head splitting.; excellent flavor, very tender, crisp, juicy, sweet, slightly spicy.
Atlantis	2	2	1	1	4	4	Uniform size; attractive heavy heads; very good flavor, tender, juicy, crunchy, mild, sweet.
Morris	2	2	2	2	4	4	Uniform size; attractive; tight internally; taste dry, crisp, slightly spicy.
Gideon	2	2	2	2	4	4	Fairly uniform in size; excellent wrapper leaves; leaves drain water well; sweet, juicy, crunchy, and slightly spicy.
Super Red 80	2	2	2	4	4	4	Uniform in size; very solid interior; sweet, juicy, crunchy, somewhat spicy.
Azurro	2	2	2	4	4	4	Somewhat variable in size; taste crunchy, juicy, spicy.
Dynamo	2	2	2	4	4	4	Very uniform size; attractive, very dense small heads; taste crunchy, dry.

[Z] Start of processing test on 7/17/99. 1 = excellent; 2 = good; 3 = bad. Slaw was washed with water containing 100-125 ppm chlorine at a pH of 6.0-6.5 at a temperature of 33-36°F prior to storage.
[Y] Rated as 1 = very good; 2 =good; 3 = fair; 4 = bad.
[X] Processed quality of slaw after storage at 50°F for 6, 11, 17, and 21 days. Eleven days is the normal expected storage life.

Insect Control on Spring Broccoli Including Organic Alternatives

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Introduction

Imported cabbageworm, cabbage looper, diamondback moth larvae, and cross-striped cabbageworm can be early-season pests of cabbage. These pests can cause severe damage to young transplants as well as cause serious leaf feeding damage to older plants. Damage to the head or wrapper leaves often leads to market culls. Because many of these pests are much more difficult to control as large larvae, controls will always be most effective when directed toward small larvae, so early detection of economic infestations is critical to the management of these pests.

Successful control of cabbage pests, particularly the leaf-feeding caterpillars, depends on proper pest identification, timing of applications, and insecticide coverage. Because the different caterpillars species may be susceptible to different insecticides, it is important to identify the species involved in an infestation. Most of the eggs of the foliage-feeding caterpillars are laid on the undersurfaces of the leaves, and the larvae, until mature, tend to feed on the underside of the leaves or in the bud. Thus, obtaining necessary coverage of the plants with an insecticide is difficult. Because of the leaf texture of these crops, addition of spreading and sticking agents should also be used to improve coverage.

Materials and Methods

Nine insecticides were evaluated for control of diamondback moth, cabbage looper, and imported cabbageworm larvae on broccoli ('Sultan'). The test plot was located at the University of Kentucky Spindletop Research Farm in Lexington, KY. The test was arranged as a randomized block design with four replicates. Individual plots consisted of a single row 16.4 ft long, with 6.5 ft between rows. Broccoli plants were transplanted on April 8. The test included organically-approved products: Lepinox (a new Bt formulation), Hot Pepper Wax, and Bioneem. All insecticide treatments were applied with a CO_2 backpack sprayer using 40 psi and 30 gallons finished spray/acre using 3 TX12 hollow cone nozzles. A surfactant, X-77, was included with each of the treatments at the rate of 0.25% volume/volume. Plots were sprayed on May 25, June 2, and June 8, when larval infestation exceeded 30% infested plants. On May 24 and 31 and June 7 and 15 the number of larvae were recorded from each of five plants/plot.

Results and Discussion

Pest pressure from imported cabbageworm and diamondback moth larvae was intense. On the last sampling date, some of the treatments contained high numbers of small larvae that had hatched subsequent to the last spray. Weather conditions during this study were very dry. Only the Bt product Lepinox was effective among the three organically approved products included in the test. Overall, Hot Pepper Wax, and BioNeem did not provide adequate protection of the plants. All of the other treatments controlled the cabbageworm complex satisfactorily throughout the test period.

Table 2. Diamondback moth larvae/5 plants.

Treatment	Rate/ Acre	24 May[1]	31 May	7 Jun	15 Jun
SpinTor 2SC	3 fl. oz	2.25 ab	0.50 c	0.00 b	0.00 b
SpinTor 2SC	6 fl . oz	5.00 a	0.00 c	1.00 ab	0.00 b
Mustang 1.5 EW	3.8 fl. oz	3.25 ab	0.75 c	0.25 ab	0.00 b
Warrior T	1.96 fl. oz	1.25 b	0.25 c	0.25 ab	0.75 b
Pounce 3.2 EC	6 fl. oz	1.25 b	0.00 c	0.00 b	0.75 b
Phaser 3 EC	1 qt	2.25 a	3.00 bc	4.75 ab	1.50 b
Hot Pepper Wax	19.2 qt	2.50 ab	5.25 ab	5.25 ab	15.25 a
Bioneem	7.2 qt	4.50 ab	4.75 ab	6.50 a	4.00 a
Lepinox	1 lb	2.50 ab	0.50 c	0.50 ab	0.50 b
Control		3.00 ab	6.50 a	4.50 ab	12.00 a

[1] Means within the same column followed by the same letter are not significantly different (LSD p>0.05).

Table 1. Imported cabbageworm larvae/5 plants.

Treatment	Rate/ Acre	24 May[1]	31 May	7 Jun	15 Jun
SpinTor 2SC	3 fl. oz	1.00 a	0.25 b	0.00 c	19.25 bc
SpinTor 2SC	6 fl. oz	0.50 a	0.25 b	0.00 c	13.00 bc
Mustang 1.5 EW	3.8 fl. oz	0.50 a	0.25 b	1.25 c	20.50 bc
Warrior T	1.96 fl. oz	0.75 a	0.25 b	0.25 c	4.50 c
Pounce 3.2 EC	6 fl.oz	0.75 a	0.00 b	0.25 c	2.25 c
Phaser 3 EC	1 qt	1.50 a	0.50 a	24.00 a	18.00 bc
Hot Pepper Wax	19.2 qt	1.00 a	0.50 ab	23.25 a	70.50 a
Bioneem	7.2 qt	2.75 a	0.25 b	7.25 abc	36.25 b
Lepinox	1 lb	0.50 a	0.00 b	17.75 ab	6.75 c
Control	-	1.25 a	1.50 a	14.75 abc	91.50 a

[1] Means within the same column followed by the same letter are not significantly different (LSD p > 0.05).

Table 3. Cabbage looper larvae/5 plants.

Treatment	Rate/Acre	24 May[1]	31 May	7 Jun	15 Jun
SpinTor 2SC	3 fl. oz	0.00 b	0.00 b	0.00 a	0.00b
SpinTor 2SC	6 fl . oz	0.00 b	0.00 b	0.00 a	0.00
Mustang 1.5 EW	3.8 fl. oz	0.00 b	0.00 b	0.75 a	0.00 b
Warrior T	1.96 fl. oz	0.00 b	0.00 b	0.00 a	0.75 ab
Pounce 3.2 EC	6 fl. oz	0.00 b	0.00 b	0.00 a	0.75 ab
Phaser 3 EC	1 qt	0.00 b	0.00 b	0.00 a	0.50 ab
Hot Pepper Wax	19.2 qt	0.00 b	0.00 b	0.00 a	0.50 ab
Bioneem	7.2 qt	0.00 b	0.00 b	0.00 a	1.50 a
Lepinox	1 lb	0.25 a	0.00 b	0.25 a	0.00 b
Control	-	0.00 b	0.25 a	0.25 a	0.50 ab

[1] Means within the same column followed by the same letter are not significantly different (LSD p>0.05).

Pumpkin Cultivar Evaluation in 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 sales. However, problems with Howden's fruit set during high temperatures and Fusarium fruit rot have created a need for better cultivars.

Materials and Methods

A pumpkin cultivar trial was conducted at the University of Kentucky Robinson Substation at Quicksand, KY. Ten cultivars, two of which were small or miniature pumpkins, were evaluated in a randomized complete block design with four replications. Seeds were planted directly in the field on May 28. 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. Soil test results for this site are shown in Table 1.

Table 1. Pumpkin cultivar soil test results (lb/acre).

pH	Buf-pH	P	K	Ca	Mg	Zn
6.6	6.8	74	228	4257	268	13.6

A total of 100 lb of actual nitrogen was applied during the growing season. Fifty lb/acre of N (ammonium nitrate) was applied as a side dressing (7/5/99) one week after planting. The second and final side dressing of ammonium nitrate was applied when the vines began to run. Curbit EC at 2 pt/acre was applied immediately after planting on 5/28/99. A total of six pest control sprays was applied during the growing season for disease and insect control as conditions warranted. Drip irrigation was applied as needed. Growing conditions during the season were excessively hot and very dry. Drip irrigation was needed to obtain pumpkin seed germination.

Results and Discussion

Pumpkin yields were the highest ever obtained at Quicksand. The ability to control water applications in a timely manner (more frequent applications without foliage wetting) may have helped contribute to the higher-than-normal yields. None of the standard pumpkin cultivars showed any significant difference in fruit number/acre (Table 2.). The best yielding large jack-o'-lantern pumpkins in the trial were: Trax, Appalachian, Gold Rush, and Gold Strike. All four produced nice-looking fruit. Gold Rush and Gold Strike were the most attractive, uniform jack-o'-lantern cultivars in the trial. They produced excellent yields of 20-pound pumpkins that were blocky and dark orange in color with excellent stems (Table 2.). Appalachian had more late maturing green fruit than any of the other cultivars, and its handles were not as nice as those of the best cultivars. Pro Gold 510, which has done well in past years, was not as good in 1999. Yields of sound fruit from plot to plot were variable, and there was more rotted fruit in the Pro Gold 510 plots. Pro Gold 510 also had poorer fruit color and a handle rating that was lower than the best large fruited cultivars. It also produced significantly fewer pounds/acre than the other large jack-o'-lantern types.

Both Gold Standard and Rex 38041 gave high yields of very uniform mid-sized pumpkins, which would be well suited for schoolchildren who might not be able to pick up the larger fruited pumpkin cultivars. Both cultivars had very good handles; however, Gold Standard was more uniform and had a handle that was slightly more attractive than the numbered cultivar. Gold Standard, a slightly smaller pumpkin, is exceptionally attractive. It appears to be a smaller version of Gold Rush and may have resistance to fruit and stem decay problems. No powdery mildew was seen on Gold Standard's handles at harvest. Those wanting an attractive mid-sized pumpkin should include it in their trials.

Baby Bear and RWS 6260 were very attractive, small, dark orange pumpkins. They had significantly higher fruit numbers/acre than the large-fruited cultivars. Both cultivars are excellent as small decorative pumpkins.

Table 2. Yield and quality of pumpkin cultivars, Quicksand, KY.
Yield data are means of four replications.

Cultivar	Seed Source[a]	Fruit Number/ Acre	Lb/Acre	Avg Wt (lb)	Shape[b]	Smooth-ness[c]	Ribbing[d]	Color[e]	Stem Quality[f]	Stem Color[g]	Comments
Gold Rush	Rupp	2,841	80,184	28.3	2	3	3	DO	3.5	DG	Very nice, averaged 1.75 green fruit/plot, no powdery mildew seen on handles.
Appalachian	Peto	4,165	80,168	19.3	2	3	3	DO	2.5	DG	Nice, averaged 4.25 green fruit/plot, some powdery mildew seen on handles.
Pro Gold 510	Rupp	2,958	57,442	19.3	2	3	3	DO	2.4	MG	Fairly nice, averaged 0.75 green fruit/plot. Some rotted fruit in each plot.
RWS-5668	Rogers	3,231	69,400	21.5	2	3	2	DO	2.6	DG	Attractive, averaged 1.25 green fruit/plot.
Gold Strike	Rupp	3,464	73,195	21.2	2	3	3	DO	2.8	DG	Very pretty fruit, averaged 1.25 green fruit/plot.
Baby Bear	Rupp	12,184	20,725	1.7	1	4	3	DO	2.7	T	Attractive oblate fruit, averaged 5 green fruit/plot.
Trax	Seedway	3,503	85,363	24.5	2	3	3	DO	2.5	DG	Fair appearance, some size variability, averaged 1.25 green fruit/plot.
RWS-6260	Rogers	13,235	38,353	2.9	2	3	3	DO	2.8	DG	Nice-looking miniature pumpkin, averaged 0.5 green fruit/plot.
Gold Standard	Rupp	4,476	56,289	12.3	2	3	3	DO	3.3	DG	Very nice-looking fruit, averaged 1.75 green fruit/plot.
Rex 38041	Rupp	3,620	55,809	15.6	2	3	3	DO	3.0	DG	Pretty but not as nice as Gold Standard, averaged 3 green fruit/plot.
LSD (P = 0.05)		3,414	1,080	3.6					0.3		

LSD (0.05): Numbers followed by the same letter are not significantly different at the 5% level.
[a] Rupp Seeds Inc., Rogers Brothers, Peto Seed.
[b] 1 = oblate or flat, 2 = blocky, 3 = round.
[c] 1 = rough warty skin, 5 = very smooth.
[d] 1 = heavy ribbed, 5 = no ribbing, smooth.
[e] LO = light orange, MO = medium orange, DO = dark orange, RO = reddish orange, W = white.
[f] 1 = weak, small, breaks off; 3 = strong and large.
[g] LG = light green, MG = medium green, DG = dark green, T = tan.

Powdery Mildew Tolerant Pumpkin Cultivar Evaluation

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Introduction

Pumpkin acreage in Kentucky has been increasing over the past five years due to our reduced transportation costs for shipping to the South as compared to more northern-producing states, low levels of phytophthora disease, and the development of co-operatives that market pumpkins. Powdery mildew is a disease that shows up annually and develops as a white powder on the leaves and fruit stems, causing leaf death as well as fruit stem browning and shriveling. If powdery mildew kills the leaves too early in the season, photosynthesis is reduced, resulting in thin-walled light pumpkins that do not store well. Growers have used Bravo throughout the season to obtain low level control of this disease. When powdery mildew disease pressure became intense, Benlate or Bayleton were applied with Bravo on a 14-day schedule. When the company that manufactured Bayleton ceased production, considerable interest in varieties that have powdery mildew tolerance developed. A trial was conducted to evaluate powdery mildew tolerant pumpkin varieties at the University of Kentucky South Farm in Lexington. The purpose of this trial was to compare yields, fruit quality, and powdery mildew disease tolerance between tolerant varieties and our main commercial varieties. With a good powdery mildew tolerant variety, growers could use Bravo throughout the season and may not need to use Benlate or Balyeton when powdery mildew pressure increases. After this plot was established, Quadris was labeled for powdery and downy mildew control on pumpkins, providing us with another tool to manage these diseases.

Materials and Methods

Seven powdery mildew tolerant and two susceptible pumpkin cultivars were planted in cell packs on June 1 and transplanted to the field on June 23. Each plot, replicated four times in a randomized complete block design, consisted of a single row 20 ft long containing six plants. Each block consisted of a single row of the nine varieties that were evaluated. A long single row of the powdery mildew susceptible variety 'Howden' was planted between each block and on the outside edges of the field to enhance powdery mildew buildup and uniform spread throughout the trial. Transplants were set by hand and spaced 4 ft apart in the row with 10 ft between rows. Plots were trickle irrigated based on soil tensiometer readings.

Fifty pounds of N/acre as ammonium nitrate was applied and disked in prior to planting. Command at 1 pt/acre was applied prior to transplanting and Curbit at 5 pt/acre was applied on July 7 for weed control. Sprays of Asana, Pounce, and Thiodan were used for insect control. Plants were sprayed weekly, and Bravo was included in every application. An application of Ridomil Gold Bravo was made late in the season for downy mildew control.

Results and Discussion

The season was extremely hot and dry, and yields suffered accordingly in spite of regular irrigation. Powdery mildew was the primary disease affecting the plants. Plots were harvested on September 17 and October 7.

Table 1. Powdery mildew tolerant pumpkin yield and fruit characteristics.
Yield data are means of four replications, Lexington, KY, 1999

Cultivar	Days to Harvest	Seed Source	Yield (cwt. lb/a)	Fruit (no./a)	Avg Fruit wt. (lb)	Fruit Length (in.)	Fruit Width (in.)	Uni-formity of Size (1-5)[1]	Fruit Shape (1-6)[2]	Uni-formity of Shape (1-5)[3]	Fruit Smooth-ness (1-5)[4]	Fruit Ribbing (1-5)[5]	Fruit Color (1-3)[6]	Rotten Fruit (%)	Sun-burned Fruit (%)
Magic Lantern	115	HA	315	2,900	11.0	10.8	8.6	3.3	2,3,6	1.8	3.0	3.1	2.8	3	5
HMX6687		HA	291	3,100	9.3	9.5	8.5	3.4	1,2,3	2.3	2.9	3.0	2.3	11	6
Howden	115	HA	218	1,700	13.4	10.4	9.0	3.9	3,6	3.1	2.9	2.4	2.3	0	2
Pro Gold 510	95	RU	194	1,600	12.4	10.1	8.9	2.8	1,2,6	2.6	3.5	2.6	2.3	16	0
Merlin	115	HA	193	2,700	7.1	8.9	8.0	3.8	1,2,3	2.1	2.4	2.6	2.9	2	0
HMX6688		HA	160	4,400	3.7	5.8	6.1	1.4	3	1.3	1.8	3.1	3.0	0	0
Hybrid Pam	100	SW	156	4,100	3.8	5.3	6.1	1.9	3	1.4	3.1	3.1	2.5	0	1
RWS 6260		NV	146	7,800	1.9	4.6	4.9	2.3	3	1.6	4.4	3.8	1.3	2	2
Wee-B-Little	110	SW,JS	12	2,500	0.4	2.3	3.1	2.6	1	1.6	4.9	4.5	1.0	0	0
Waller-Duncan LSD (P = 0.05)			67	1,200	1.6										

[1] Rated 1 = very uniform to 5 = extremely variable.
[2] Fruit shape 1 = flat, 2 = blocky, 3 = round, 4 = pointed, 5 = blunt and 6 = elongated.
[3] Rated 1 = very uniform to 5 = extremely variable.
[4] Rated 1 = roughly textured to 5 = smooth.
[5] Rated 1 = heavily ribbed to 5 = no ribbing.
[6] Rated 1 = light orange, 2 = medium orange and 3 = dark orange.

'Magic Lantern' and 'HMX6687,' had significantly higher yields than other varieties in this trial. The two commercial varieties, 'Howden' and 'Pro Gold 510,' which are commonly grown in Kentucky and do not have powdery mildew tolerance, yielded well in comparison with the other varieties. All of the powdery mildew tolerant varieties had significantly less powdery mildew on the plants than the varieties without powdery mildew tolerance with the exception of 'Hybrid Pam,' which is not advertised as having powdery mildew tolerance. The best and most attractive powdery mildew tolerant varieties in this trial were 'Magic Lantern,' HMX6687,' 'Merlin,' 'HMX6688,' and 'RWS 6260.'

After harvesting, four pumpkins of each variety were left on tables at room temperatures in the field lab building to observe storage characteristics. On October 29, none of the varieties showed decay, but the stems on 'HMX 6687,' 'Wee-B Little,' and some stems on 'Merlin' showed considerable shriveling. At this time 'RWS 6260' was particularly attractive, with its bright orange color and long, thin, dark green stems.

Table 2. Pumpkin variety fruit stem, plant characteristics, and powdery mildew incidence, Lexington, KY, 1999.

Cultivar	Stem Quality (1-3)[1]	Stem Color (1-3)[2]	Stem Prickliness (1-5)[3]	Plant Habit (1-3)[4]	PM Rating[5] 8/26 (%)	PM Rating[5] 9/14 (%)	PM Stem Rating[6] (1-5)	Comments
Magic Lantern	2.1	3.0	3.8	3.0	3	13	1	Nice, attractive pumpkin; no powdery mildew on stem; nice color, shape, & attractive dark green stems.
HMX6687	2.6	3.0	3.5	3.0	0	6	1	
Holden	2.5	3.0	3.0	2.5	25	66	2	Attractive pumpkin; good stem.
Pro Gold 510	2.4	2.8	3.1	3.0	21	61	2	Some mildew on stem.
Merlin	2.1	3.0	3.0	3.0	7	15	1	Attractive dark orange fruit with dark green stems.
HMX6688	3.0	2.8	3.8	3.0	1	11	1	Variable stem thickness, generally thick; small brown flecks on skin; attractive, nice shape.
Hybrid Pam	2.5	2.0	4.1	3.0	21	59	2	Nice, attractively shaped fruit; stems not as good.
R.S. 6260	2.0	3.0	3.3	2.0	1	9	1	Nice, long, dark green, attractive stem; attractive pumpkin.
Wee-B-Little	2.0	2.8	1.5	1.0	0	4	1	Has warts.
Walker-Duncan LSD (P = 0.05)	0.44	0.67	0.7		11.5	15.6		

[1] Rated 1 = weak/small to 3 = strong/large.
[2] Rated 1 = light green, 2 = medium green and 3 = dark green.
[3] Rated 1 = no prickliness to 5 = very prickly.
[4] Plant vine characteristics: 1 = bush, 2 = small vine and 3 = large vine.
[5] Powdery mildew rating is estimate of the percent powdery mildew (incidence) on the plant multiplied by percent area of infected leaves with powdery mildew (severity).
[6] Stem rating: estimate of incidence of fruit stems with powdery mildew: 1 = no trace of powdery mildew; 2 = 1-25%; 3 = 26-50%; 4 = 51-75%; 5 = 76-100% of stems with fungal growth or browning traces.

Seeded and Seedless Watermelon Cultivar Evaluation

John Strang, Kay Oakey, Darrell Slone, Dave Lorry, and John Snyder, Department of Horticulture

Introduction

Over the past several years many new seedless or tripod watermelons have been introduced by seed companies. This trial was initiated to evaluate these new varieties for performance in Kentucky. These trials were conducted at the University of Kentucky South Farm in Lexington. Seventeen seedless and five seeded watermelon cultivars were evaluated.

Materials and Methods

Seeds were planted in the greenhouse on April 28, 1999, and transplanted to the field on June 10. Each plot consisted of a single row 20 ft long containing six plants and was replicated four times in a randomized complete block design. Plants were transplanted with a waterwheel setter and spaced 4 ft apart in the row with 10 ft between rows. Black plastic mulch was used on raised beds that were trickle irrigated based on soil tensiometer readings.

One hundred lb of N as ammonium nitrate and 150 lb of K_2O/acre were applied and disked in prior to laying black plastic mulch. Cubit at 4 pts/acre was applied after transplanting for weed control on the bare ground. Sprays of Asana, Ambush, Thiodan, and Kelthane were used for insect and mite control, and Bravo and fixed copper were used for disease control.

Results and Discussion

The season was very hot and dry, and this appeared to reduce the degree of redness of watermelon flesh. The trickle irrigation was stopped approximately two weeks prior to harvest to increase melon sugar content. Irrigation was resumed on a limited basis when the plants began wilting. Magnesium deficiency was apparent in the plants during the hottest period of the season, although this site is not low in magnesium. Yield calculations were based on only the melons that weighed 10 lb or more. Some of the varieties had a considerable number of melons less than 10 lb in weight. Consequently, these appear not to have yielded as well.

Seedless Watermelons

The best performing red seedless cultivars in this trial were 'Triple Prize,' 'Sterling,' 'Triple Star,' 'Tri-X-Triple Sweet,' and 'Tri-X-Shadow.' 'Sterling' was outstanding. It was by far the largest seedless variety and was elongated in shape. The best performing yellow cultivar of the two was 'Solid Gold,' although some of the fruit had darkened seed traces.

Seeded Watermelons

The best large, long watermelon in this trial was 'Royal Majesty.'

Table 1. Seeded and seedless watermelon yield, fruit size measurements, and seed germination percentages.
Yield data are means of four replications, Lexington, KY, 1999.

Cultivar	Melon Type[1]	Seed Germination 4/21/99 (%)	Seed Source	Days to Harvest	Marketable Melon Wt > 10 Lb (cwt. lb/a)	No. Mkt Melons/A	Marketable Melon Wt (lb)	No. Melons/A <10 Lb (culls)	Outside Measurements length (in)	Outside Measurements width (in)	Rind Thickness[2] (in.)
Triple Prize	T	62	SW	85	730	4,500	16.2	91	11	10	0.7
Sterling	T	65	SW	92	612	2,900	21.2	145	17	9	0.7
Triple Star	T	87	SW, RU	85	611	3,800	16.0	272	12	9	0.7
Seedway 4502	T	85	SW	90	592	3,300	17.9	635	11	10	0.6
Tri-X-Triple Sweet	T	69	NV	85	588	3,500	16.8	590	11	10	0.8
Tri-X-Carousel	T	72	NV	90	587	3,600	16.5	272	12	10	0.6
Tri-X-Shadow	T	62	NV	88	569	3,600	15.7	817	11	9	0.7
RWM 8073-VP	T	84	NV	88	559	3,300	17.1	272	11	9	0.7
Laurel	T	97	SW	90	558	3,700	15.2	318	10	9	0.6
Summer Sweet 5544	T	42	AC	88	556	3,500	15.9	272	12	10	0.7
Royal Majesty	S	100	PS	82	550	2,600	21.3	0	17	9	0.6
Royalty	S	98	RU	85	550	2,200	15.2	45	9	9	0.7
Solid Gold	T	78	SW	80	547	3,200	17.0	136	10	9	0.5
Dumara	S	100	SW, NU	85	516	2,500	21.1	45	15	10	0.6
Tri-X-Brand Chiffon	T	31	NV	80	514	4,500	11.4	635	9	9	0.6
Triple Crown	T	52	SW	85	513	3,100	16.6	545	12	10	0.7
Tri-X-Palomar	T	37	NV	88	511	3,400	15.1	835	10	10	0.7
Mardi Gras	S	51	SW	88	489	2,200	22.4	45	17	9	0.7
Tri-X-626	T	61	NV	85	477	3,200	14.8	862	11	10	0.6
Imperial	S	94	RU	85	474	2,300	20.9	0	11	10	0.5
Summer Sweet 5244	T	95	AC	90	450	2,600	17.4	771	12	10	0.7
Waller-Duncan LSD (P = 0.05)					238	800		704			0.2

[1] S = seeded; T = triploid or seedless.
[2] Rind thickness from outside surface to inside color.

Table 2. Seeded and seedless watermelon fruit characteristics, Lexington, KY, 1999.

Cultivar	Hollow Heart[1] (0-2)	Sugar[2] (%)	Flavor[3] (1-5)	Seed Number[4]	Interior Color[5]	Comments
Triple Prize	0.0	11.6	5.0	3.5	MR	Medium-wide stripes over light background; attractive interior; some dark seed traces becoming fibrous.
Sterling	0.3	12.3	5.0	3.0	MR	Very wide, dark green stripes with light green to cream background; very nice interior color; very red.
Triple Star	0.0	11.7	4.7	0.3	LR	Wide, dark green stripes; very attractive interior and exterior; excellent taste; sweet, attractive interior.
Seedway 4502	0.3	10.4	4.1	3.3	DR	Wide, dark green stripes; very attractive interior.
Tri-X-Triple Sweet	0.5	10.7	4.5	1.8	MR	Medium-wide stripes; attractive exterior.
Tri-X-Carousel	0.4	10.7	4.4	1.0	LR	Wide, dark green stripes. Rind thickness varies from 0.4 to 0.7 inches.
Tri-X-Shadow	0.0	11.4	4.8	0.0	DP	Stripes not apparent; light green background; a few dark seed traces.
RWM 8073-VP	0.3	10.8	3.9	9.0	LR	Medium-wide, dark green stripes on light background; outstanding flavor; lots of hard seed traces; attractive bright-red interior.
Laurel	0.1	11.5	4.3	12.5	DP	Medium width, medium dark green stripes on light background; attractive; some dark seed traces.
Summer Sweet 5544	0.0	10.9	4.2	0.3	DR	Medium dark green, medium width stripes on light background; attractive pink interior.
Royal Majesty	0.4	12.3	4.8		MR	Wide dark green stripes; attractive; very symmetrical and uniform; outstanding flavor.
Royalty	0.3	11.8	3.9		MR	Wide dark green stripes; tender; nice interior color; fairly symmetrical; watery aftertaste.
Solid Gold	0.0	11.1	4.1	1.8	MBY	Light background with dark green, narrow stripes; very attractive yellow; very sweet; darkened seed traces in some melons.
Dumara	0.3	11.6	4.3		LR	Nice wide, dark green stripes; attractive exterior.
Tri-X-Brand Chiffon	0.0	10.4	3.1	0.5	MBY	Round; medium dark green stripes with light green background; difficult to tell where rind begins; some darkened seed traces.
Triple Crown	0.0	11.0	4.6	7.0	MR	Wide, medium dark green stripes over a light green background; nice flavor.
Tri-X-Palomar	0.0	11.1	4.6	2.5	DP	Narrow dark green stripes over medium green background; stripes not apparent; excellent flavor; some dark seed traces and some hard white traces. Interior not attractive; very sweet, firm flesh.
Mardi Gras	0.5	11.2	3.8	4.5	MR	Very wide medium green to dark green stripes; attractive, symmetrical.
Tri-X-626	0.0	10.8	4.5		MR	No stripes; attractive interior.
Imperial	0.5	11.3	4.6		DR	Medium dark green stripes; blossom end of rind very thin; nice interior color; excellent flavor.
Summer Sweet 5244	0.0	10.6	4.7	1.0	MR	Medium dark green stripes; nice interior; excellent taste; very sweet.
Waller-Duncan LSD (P = 0.05)	1.2	1	1	7		

[1] Hollow heart 0 = none; 1 = hollow heart.
[2] Sugar measured by refractometer.
[3] Flavor 1 = poor; 5 = excellent.
[4] Seed number counts/melon on triploid varieties only.
[5] Interior color: DP = dark pink; LR = light red; MR = medium red; DR = dark red; MBY = medium bright yellow.

In Search of the Kentucky Tomato: Yield, Income, Taste, and Quality of Staked Tomato Cultivars

Brent Rowell, Terry Jones, John C. Snyder, Janet Pfeiffer, and Darrell Slone, Department of Horticulture

Kentucky growers currently produce about 1,200 acres of staked, vine-ripe tomatoes for local and national markets. Kentucky tomatoes have an excellent reputation for quality among buyers in several Midwestern states. Managers at the Kroger Company's regional distribution center in Louisville (serving 100 supermarkets in Kentucky, Illinois, and West Virginia) have expressed a strong interest in marketing local produce in general and Kentucky tomatoes in particular.

We began fresh market tomato trials in 1998 to evaluate new and existing commercial cultivars and to identify one or more that might be featured in supermarkets as a premium "Kentucky Tomato." We evaluated cultivars for yields, appearance, firmness, and taste and compared them with well-established commercial cultivars like 'Mountain Spring' and 'Mountain Fresh.' We were looking specifically for the following characteristics in the "Kentucky Tomato":

- large slicer that tastes good and ships reasonably well (firm, but not necessarily the most firm among cultivars).
- high yields of extra large and jumbo size classes.
- low frequency of fruit defects.

Materials and Methods

A carefully selected group of 14 determinate tomato varieties from four seed companies was evaluated at two locations in Kentucky. Ten of these cultivars had been tested in the previous year's trials. All trial entries for both locations were seeded in the greenhouse at the UK Horticultural Research Farm in Lexington (LEX) on 17 March and subsequently transferred to 72-cell plastic trays. Cultivars were transplanted to the field on 10 May at LEX and on 11 May at the Robinson Experiment Station at Quicksand (QSND). An additional cultivar, 'Mountain Supreme,' was included in the QSND trial because of its early blight tolerance. Cultivars at both locations were planted in a randomized complete block design with four replications. Plots at LEX consisted of eight plants spaced 18 in. apart in a single row on 6 in. high raised beds spaced 6 ft apart with black plastic mulch and trickle irrigation. Plots at QSND were similar except that 10 plants/plot were used on beds spaced 7 ft apart.

Drip irrigation was applied as needed according to tensiometers used to monitor soil moisture at both locations. Plants at both locations were staked and tied using the Florida weave system and pruned to two main stems except for 'Sunstart' and 'Sunshine,' which were not pruned at LEX. Fifty pounds of nitrogen, no phosphorus, and no potassium were applied prior to bed formation at QSND, and 114 lb/acre each of N, P_2O_5, and K_2O were applied at LEX. A total of 66 lb/acre of supplemental N (ammonium or calcium nitrate) was fertigated at QSND from 26 May to 29 July in 11 weekly applications of 6 lb N/acre. A total of 80 lb/acre of supplemental N (ammonium nitrate) was fertigated at LEX from 7 June to 20 July in five applications of 10-20 lb N/acre. Both plots were sprayed weekly with protectant fungicides (Bravo and Quadris at QSND and Bravo alternated with Quadris at LEX). Insecticides (Thiodan, Pounce) were added as needed to the weekly fungicide sprays.

A total of 13 harvests were made at LEX from 2 July until 23 Aug, and 11 harvests were made at QSND from 4 July to 17 Aug. Fruit was graded into the following size classes prior to counting and weighing: Jumbo (>3.5 in. diameter), extra large (>2.75 in. but # 3.5 in.), large (>2.5 in. but #2.75 in.), medium and small (#2.5 in), and cull. Fruits were also sorted according to U.S. No. 1 or U.S. No. 2 grades. In order to approximate the present marketing situation in Kentucky, "marketable yield" included only the "large" and above-size classes. Yields of the "medium" size class are reported together with the small class, as they are not considered worth marketing by most grower/shippers in the state. All yields reported in Tables 2 and 3 are of U.S. No. 1 fruit unless otherwise indicated. Yields of No. 2 fruits, although marketable in most years, were not included in "marketable yield" and are reported in separate columns in the tables.

Means of all variables were compared using Waller-Duncan's K-ratio T test (P = 0.05).

Income/acre. In addition to reporting yields in terms of pounds or cartons/acre, variety performance is also expressed as income/acre. Actual 1999 weekly tomato market prices (Table 1) were multiplied by yields from the different size classes for each variety. Higher prices used for the first three weeks of harvests favor earlier-maturing varieties. Higher prices were also obtained for the "extra large+jumbo" size class. Yields of No. 2 fruits were also used in these calculations but with lower prices than No. 1 fruits. We consider the incomes/acre together with fruit quality observations in Table 4 to provide the best indication of overall variety performance.

Table 1. Actual farm gate prices received by Cumberland Farm Products Cooperative growers, 1999.

Yields of each size class/grade were multiplied by these prices for the appropriate harvest dates to calculate "income/acre" for each cultivar at QSND and LEX.

	Price/Lb		
Week ending	#1 Jumbo & X-large	#1 Large	#2's (Jum, X-Lg, Lg, Med)
3 July	$0.31	$0.16	$0.20
10 July	0.33	0.16	0.18
17 July	0.28	0.18	0.15
24 July	0.25	0.13	0.14
31 July	0.17	0.09	0.065
6 Aug-23 Aug[z]	0.12	0.05	0.06

[z] Cumberland Farm Products Cooperative discontinued packing on 7 Aug. We used its 6 Aug prices for income calculations for all trial harvests after that date.

Table 2. Yields of staked tomatoes at Quicksand, Kentucky, 1999.

All data are means of four replications.

	---- #1 Jumbo+X-Lg[t]----			#1 Large[u]	Tot. Mkt[v]	# 2's[w]	Meds+ Smalls[x]	Culls	Avg Fruit Wt[y]	Income
Entry (Seed Co.)	**boxes/acre**	**%**	**-----------------lb/acre (thousands)-----------------**						**oz**	**$/acre**
Fabulous (SW)	1,951	87	48.8	7.6	56.4	4.7	4.0	5.2	11.6	8444
Florida 47 (AS)	1,907	78	47.7	12.7	60.3	4.2	4.6	2.5	10.4	8066
Mtn. Fresh (H)	1,832	74	45.8	15.7	61.4	1.9	5.1	1.5	9.8	7794
Emperador (PS)	1,785	81	44.6	10.0	54.6	4.7	7.0	5.5	10.7	8151
NC 98274	1,762	80	44.0	10.8	54.8	8.8	3.7	4.8	10.7	7532
Floralina (PS)	1,747	76	43.7	13.4	57.1	4.3	5.5	3.4	10.0	7860
Mtn. Spring (RG)	1,739	77	43.5	13.5	57.0	7.5	6.5	5.0	10.2	8172
Sunleaper (RG)	1,735	75	43.4	14.2	57.6	5.9	7.6	7.2	10.1	8024
SunGem (AS)	1,664	81	41.6	9.8	51.4	7.0	5.5	3.7	10.4	7778
Sunsation (AS)	1,425	68	35.6	16.1	51.7	2.8	8.2	2.4	9.6	6462
Enterprise (SW)	1,370	72	34.2	13.1	47.4	7.3	8.7	10.6	9.8	7287
Sunchief (AS)	1,201	70	30.0	12.4	42.5	2.6	9.1	3.5	9.3	6338
Mtn. Supreme (AS)	987	50	24.7	23.1	47.8	1.7	14.3	2.3	8.0	5045
Sunstart (AS)	933	65	23.3	12.5	35.8	7.9	10.3	7.1	9.0	6698
Sunshine (AS)	926	72	23.1	8.5	31.6	8.9	7.8	7.5	9.4	6762
Waller-Duncan LSD (P = 0.05)	363	7	9.1	3.4	10.2	3.1	3.3	2.1	0.6	1561

[t] Yields of USDA No. 1 fruit of jumbo (>3.5 in. diameter) *plus* extra-large (>2.75 in. but ≤ 3.5 in.) size classes; boxes/acre = number of 25 lb cartons/acre; "%" = percentage of the total of these two size classes of the *total marketable yield*.
[u] Yields of USDA No. 1 fruit of the large (>2.5 in. but ≤ 2.75 in.) size class.
[v] Total marketable yield = yield of No. 1 fruit of jumbo + extra-large + large size classes; mediums not included.
[w] Yield of USDA No. 2 fruit from all size classes.
[x] Yield of medium + small size classes (≤ 2.5 in.,unmarketable in most years in KY).
[y] Average fruit weight; includes jumbo, extra large, and large only.

Table 3. Yields of staked tomato cultivars at Lexington, KY.

All data are means of four replications.

Entry (Seed Co.)	------#1 Jumbo+ XLg[t]------			#1 Large[u]	Tot. Mkt[v]	# 2's[w]	Meds+ Smalls[x]	Culls*	Avg Fruit Wt[y]	Income
	boxes/acre	**%**	**------------------------lb/acre (thousands)------------------------**						**oz**	**$/acre**
Sunleaper (RG)	2,850	97	71.2	2.5	73.7	10.2	0.8	15.9	9.2	13,541
Mtn. Fresh (H)	2,833	95	70.8	3.8	74.7	0.7	0.9	15.3	9.3	12,096
NC 98274	2,813	98	70.3	1.4	71.7	0.7	0.8	13.4	10.5	12,496
Floralina (PS)	2,781	96	69.5	2.8	72.3	0.6	0.5	13.2	9.6	13,200
Sunsation (AS)	2,753	95	68.8	3.7	72.5	0.5	1.2	11.2	8.9	12,523
Emperador (PS)	2,608	95	65.2	3.3	68.5	0.8	1.3	21.3	9.5	11,957
Florida 47 (AS)	2,409	97	60.2	2.0	62.2	0.9	0.7	19.1	9.8	11,267
Mtn. Spring (RG)	2,352	95	58.8	3.3	62.1	0.7	0.8	14.1	9.4	11,501
SunGem (AS)	2,306	95	57.6	2.7	60.4	11.2	0.7	14.2	9.6	12,015
Sunchief (AS)	2,157	95	53.9	2.6	56.5	0.7	0.4	11.5	9.0	11,716
Fabulous (SW)	2,156	96	53.9	2.2	56.2	15.0	0.5	21.7	10.2	11,507
Enterprise (SW)	2,130	91	53.2	5.3	58.5	10.1	0.5	22.9	9.3	11,854
Sunstart (AS)	2,003	92	50.1	4.3	54.4	0.9	2.1	21.2	8.1	13,442
Sunshine (AS)	1,736	90	43.4	4.7	48.2	0.7	2.3	19.4	8.0	11,804
Waller-Duncan LSD (P = 0.05)	387	3.7	9.7	2.9	10.2	4.4	0.9	6.5	0.7	ns

[t] Yields of USDA No. 1 fruit of jumbo (>3.5 in. diameter) *plus* extra-large (>2.75 in. but ≤3.5 in.) size classes; boxes/acre = number of 25 lb cartons/acre; "%" = percentage of the total of these two size classes of the *total marketable yield*.
[u] Yields of USDA No. 1 fruit of the large (>2.5 in. but ≤ 2.75 in.) size class.
[v] Total marketable yield = yield of No. 1 fruit of jumbo + extra-large + large size classes; mediums not included.
[w] Yield of USDA No. 2 fruit from all size classes.
[x] Yield of medium + small size classes (≤ 2.5 in.,unmarketable in most years in KY).
[y] Average fruit weight; includes jumbo, extra large, and large only.

Table 4. Fruit quality characteristics; observations from all red-ripe fruits from one replication at LEX on 6 August.
First 12 cultivars ranked in order of yield of No.1 jumbo+ extra-large fruits at LEX.

Cultivar (Seed Co.)	Shape[t]	Blossom Scar[u]	Smoothness[v]	Cracking[w]	Appearance[x]	Firmness[y]	Internal Color[z]	Comments
Sunleaper (RG)	do	s-m	r	3	6	4	4	nice internal color; ridged at top of fruits
Mtn. Fresh (H)	g	s	m	2	7	3	4	nice internal color; uniform shape
NC 98274	do	m	m	2	7	3	2	pale pink internal
Floralina (PS)	do	s-m	s	2	7	3	3	
Sunsation (AS)	g	s	s	2	6	4	2	pale pink internal; yellow shoulders (heat injury)
Emperador (SW)	g	s-m	m	3.5	5	2.5	3	yellow shoulders (heat injury); radial cracking, soft
Florida 47 (AS)	do	m	m	3.5	5	4	2	pale pink internal; radial cracking
Mtn. Spring (RG)	do	s	m	2.5	7	4	2	pale pink internal
SunGem (AS)	o-do	s	m	2	7	3	3	
Sunchief (AS)	g	s	m	3	5	3	3	yellow shoulders (heat injury)
Fabulous (SW)	do	m	m	4	5	2.5	3	radial cracking; softer than most other cvs.
Enterprise (SW)	do	lg	m	4	6	3.5	2	radial cracking; yellow shoulders (heat injury)
Very early-maturing cultivars Sunstart *and* Sunshine *had to be evaluated separately on 20 July and were compared with* Mtn. Fresh *on this date:*								
Sunstart (AS)	dg	m	s	1	7[s]	2.5	3	some yellow shoulders (heat)
Sunshine (AS)	dg	s-m	s	1	7[s]	3	3	some yellow shoulders (heat)
Mtn. Fresh (H)	dg-g	s	s	1	8	3	3	

[s] Fruits of these early cultivars had serious defects after 23 July including severe flattening, large blossom scars, and radial cracking.
[t] Fruit shape: "o" = oblate; "do" = deep oblate (diameter somewhat greater than height); "g" = globe (spherical); "dg" = deep globe.
[u] Blossom scar size: "s" = small (< 1/8 in. diameter), "m" = medium (1/8 to 1/4 in.), "lg" = large (5/16 to 7/16 in.).
[v] Smoothness of fruit shoulders: s = smooth, m = medium, r = rough (ribbed on top of fruit).
[w] Fruit cracking: 1 = none, 5 = severe.
[x] Overall fruit appearance rating: 1 = worst, 9 = best.
[y] Fruit firmness by feel: 1 = soft, 3 = medium firm, 5 = very firm.
[z] Internal fruit color: 1 = whitish (worst), 5 = uniformly deep red (best).

Fruit quality ratings. All ripe fruits of each variety from one replication in the LEX trial harvested on 3 Aug were graded and laid out for careful examination and quality ratings on 6 Aug. Fruits from two very early varieties were evaluated in the same way on 20 July and compared with 'Mountain Fresh' on that date. All cultivars were rated for smoothness, blossom scar size, extent of cracking, firmness, and internal color (Table 4). The overall appearance rating took these factors into account.

Taste tests. Although taste tests reported here were conducted in 1998, results were not available for the previous year's report. All 16 cultivars from 1998 were evaluated informally (screened) for taste at QSND on 7 Aug 1998. Three extra-large, red ripe fruits of each cultivar were sliced into thin wedges; two male and two female panelists rated varieties according to the following scale: "tastes great" (5 points), "tastes good" (3 points), "acceptable" (2 points), and "unacceptable" (no points). Scores were totaled for each cultivar.

Based on the results of the preliminary screening *and* on good 1998 fruit appearance ratings, the following cultivars were selected for more extensive blind taste tests with consumers in LEX: 'SunGem,' 'Fabulous,' 'Floralina,' 'Mountain Fresh,' and 'Mountain Spring'. FA 1001, a cluster-type indeterminate cultivar from Israel with the *rin* gene for long shelf life, was also included in the consumer test. FA 1001 was the most attractive and had the least problems with cracking among six small-fruited indeterminate cultivars evaluated in an observation trial adjacent to the 1998 replicated trial. 'Mountain Spring' had the lowest scores in the preliminary taste test and was included as a poor tasting control, and 'Floralina' was used as a good tasting control. Red ripe fruits harvested on 10 Aug from the QSND trial were used in blind taste tests conducted at Papania's Catnip Hill Farmers Market, Lexington, on 13-15 Aug 1998. Extra-large fruits of each cultivar were cut into thin wedges and put on a paper plate with 3-4 cut fruits/plate. Cultivars were tested in groups of four at a time, each group always including controls 'Mountain Spring' and 'Floralina.' Unsalted crackers and water were made available, and it was suggested that tasters cleanse palates between cultivars. A slightly different rating scale was used for the consumer tests than for the preliminary screening. Only three choices were possible: "tastes great" (3 points), "acceptable, tastes OK" (1 point), and "unacceptable" (no points). A total of 120 consumers tasted tomato cultivars in groups of 4 cultivars. Average taste scores were compared using Waller-Duncan's K-ratio T test ($P = 0.05$).

Results and Discussion

The 1999 growing season was characterized by high temperatures and extreme drought; the period from July through September 1999 was the driest ever recorded for this period during this century in Kentucky. Although drip irrigation at both locations supplied adequate water to the trials, more radial cracking occurred at LEX in 1999 than in 1998. Extremely high temperatures (6-8 degrees higher than normal during the first half of July) resulted in a significant amount of fruit with yellow shoulders and other defects in some cultivars (Table 4).

Dry weather and timely fungicide applications resulted in very little foliar disease symptoms at QSND. Problems with an air blast sprayer used at LEX resulted in good disease control in the outer two rows of the trial plot but poor spray coverage and poor disease control on the inner two rows. Although dry weather conditions precluded the development of early blight in these plots, powdery mildew became a problem and caused significant damage to foliage in the inner blocks late in the season. Although powdery mildew symptoms were obvious on most cultivars at this location, the disease appeared not to have affected yields.

Yields. The group of highest yielding cultivars at QSND included 'Fabulous' (also the highest yielding in 1998 at QSND), 'Florida 47,' 'Mtn. Fresh,' 'Emperador,' NC 98274, 'Floralina,' 'Mtn. Spring,' 'Sunleaper,' and 'SunGem'(Table 2). Many of the same cultivars were also in the highest yielding group at LEX which included 'Sunleaper,' 'Mtn. Fresh,' NC 98274, 'Floralina,' 'Sunsation,' and 'Emperador'(Table 3). 'Fabulous' did not perform nearly as well during the more severe 1999 growing season in LEX compared to 1998: it had the highest yield of No. 2 fruits and one of the highest yields of cull fruit at LEX in 1999. Most of these culls were the result of radial cracking at LEX. Among the cultivars in the highest yielding group, 'Emperador' had the lowest scores for fruit appearance at LEX. 'Florida 47' and 'Sunchief' also had relatively low appearance scores (Table 4). All of these cultivars had problems with radial cracking at LEX. Both 'Fabulous' and 'Florida 47' had good fruit appearance scores in 1998.

'Sunstart' and 'Sunshine' were by far the earliest maturing cultivars in the trial. Although season-long yields were the lowest among cultivars at both locations (Tables 2 and 3), it should be understood that most of that yield occurred before the end of July, which would have resulted in high returns/acre because of relatively high prices. Both cultivars had acceptable appearance scores during their peak harvest period (mid-July) but suffered from severe flattening and other defects after 23 July (Table 4).

Yield of 'Mountain Spring,' the most widely grown commercial variety in the state, was intermediate at LEX. 'Mountain Spring' was higher yielding relative to other cultivars in 1999 than in 1998 at QSND—probably because there were no foliar disease problems in 1999 at that location (Table 2). 'Mountain Spring' is more susceptible to early blight.

Incomes. Incomes/acre were lower in 1999 (Tables 2 and 3) than in 1998 because of lower 1999 wholesale tomato prices; however, incomes were still quite high in spite of low prices. Although incomes among cultivars at LEX ranged from $11,000/acre for 'Florida 47' to $13,500/acre for 'Sunleaper,' there were no statistically significant differences among these incomes. Interestingly, 'Sunstart,' a very early-maturing cultivar which was near the bottom of the yield list, had an income only slightly lower than 'Sunleaper' with the highest income. Most fruits from 'Sunstart' were harvested when prices were higher, prior to 24 July.

Incomes from cultivars at QSND ranged from $5,000 to $8,400/acre (Table 2). Although LEX and QSND trials were planted at the same time, most cultivars were about a week later in maturity at QSND. Average fruit size and the percentages of jumbo and extra-large fruits were lower at QSND than LEX (Figures 1 and 2), resulting in lower incomes. There were statistically significant differences in income among cultivars at QSND; the group of highest income cultivars included 'Fabulous,' 'Mountain Spring,' 'Emperador,' 'Florida 47,' 'Sunleaper,' 'Floralina,' 'Mountain Fresh,' 'SunGem,' NC 98274, and 'Enterprise.' Higher prices for early-maturing 'Sunstart' and 'Sunshine' did not compensate for their low yields at QSND, although their incomes were higher than for higher-yielding cultivars 'Sunsation,' 'Sunchief' and 'Mountain Supreme.' Yields and income from 'Mountain Supreme' were very low at this location due to its late maturity.

Fruit quality. Yellow shoulders, probably resulting from abnormally high temperatures and heat injury occurring in July, seemed to be more of a problem with cultivars 'Sunsation,' 'Emperador,' 'Sunchief,' 'Enterprise,' 'Sunstart,' and 'Sunshine' at LEX. Cultivars which were the highest yielding at one or both locations *and* which had the highest fruit appearance scores at LEX were 'Mtn. Fresh,' 'Floralina,' NC 98274, 'Mtn. Spring,' and 'SunGem.' 'Sunleaper' received a slightly lower fruit appearance score because of relatively rough (ridged) shoulders, which may not be a problem in most markets; 'Sunleaper' had very attractive fruits at QSND. Nipple-like protuberances were noticeable on the blossom ends of many 'Sunsation' fruits harvested at QSND but not at LEX. Fruits of 'Fabulous' and 'Emperador' seemed softer than other cultivars in mid-August at QSND; these two cultivars were also rated least firm among the 14 cultivars tested at LEX (Table 3).

Taste. Results of the 1998 preliminary taste test (Figure 3) were used to determine which cultivars to include in the larger consumer test; the preliminary test panel of four was too small to make any conclusions based on that test. 'Mountain Spring,' for example, was rated worst for taste in the preliminary test but rated better than "acceptable" in the larger consumer test (Figure 4). Average taste scores were highest for 'Mountain Fresh'

Figure 1. Jumbo+XL and total marketable yields.

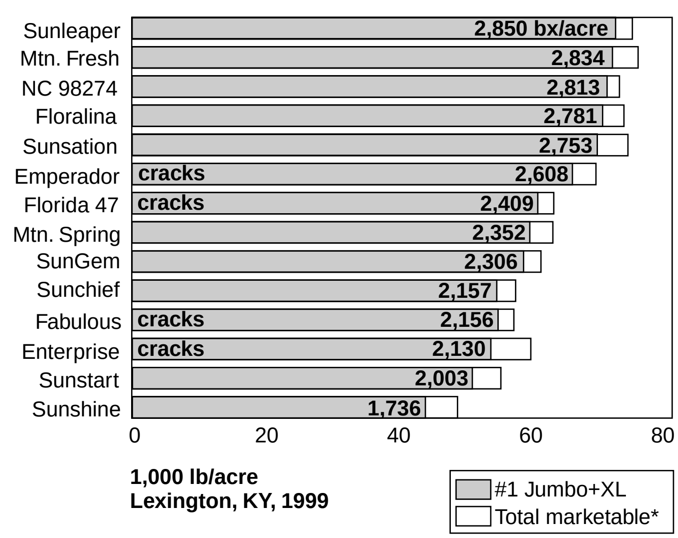


Figure 2. Jumbo+XL and total marketable yields.

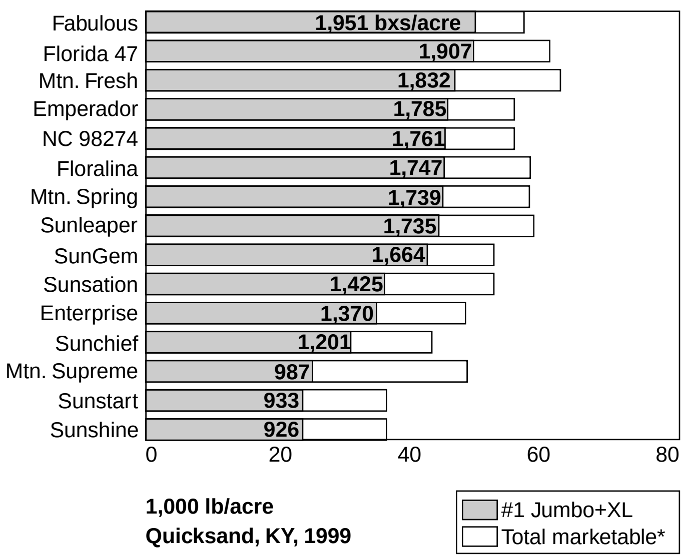


Figure 3. Preliminary taste test scores.

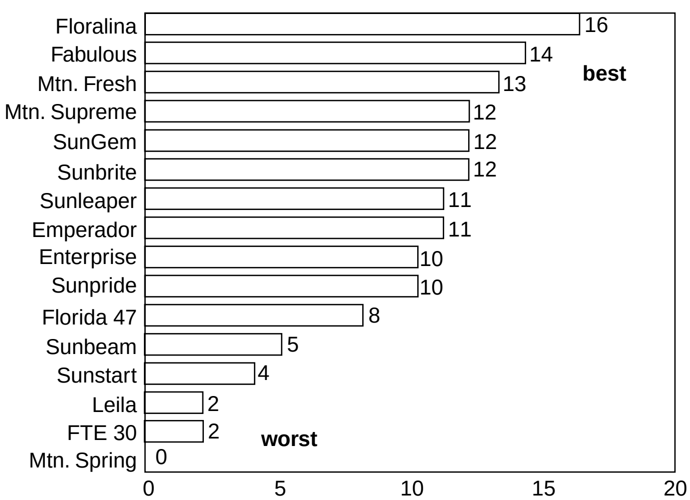


Figure 4. Consumer taste test scores.

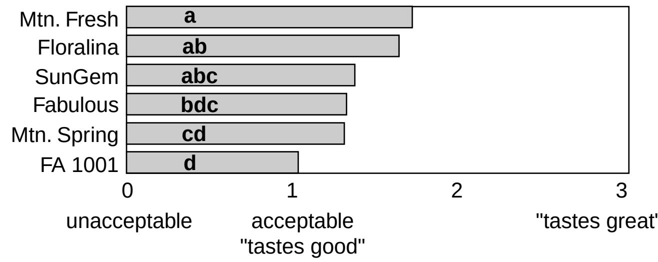
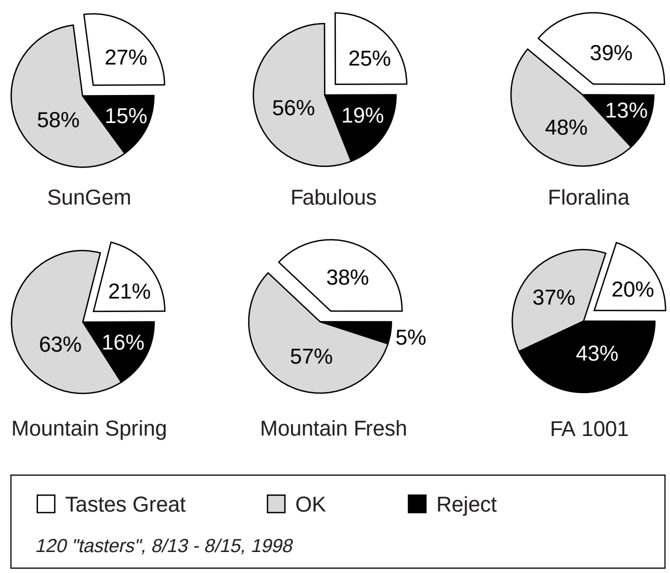


Figure 5. Percentage responses, taste test.



in the consumer test; 'Floralina' and 'SunGem' scores were not significantly different from that of 'Mountain 'Fresh' (Figure 4). 'Floralina' and 'Mountain Fresh' had the highest percentage of responses in the "tastes great" category (39% and 38%, respectively, Figure 5) followed by 'SunGem' (27%) and 'Fabulous' (25%). FA 1001 had the lowest average score and the highest percentage of "unacceptable" responses (43%).

All things considered. New cultivars 'Sunleaper,' 'Floralina,' 'SunGem,' NC 98274 (not yet released), and perhaps 'Florida 47' and 'Sunsation' deserve on-farm testing alongside well-established varieties like 'Mountain Fresh' or 'Mountain Spring.' 'Sunleaper,' a heat-tolerant variety, has also performed well in late plantings in Kentucky. Very early-maturing 'Sunstart' should be tried (without pruning) alongside main-season varieties for markets with premium prices early in the season. Some cultivars with high yield potential but susceptible to softening and cracking under extreme conditions ('Fabulous,' 'Emperador') should do well in "normal" years if drastic fluctuations in soil moisture supply can be avoided. Five of the six cultivars included in the 1998 taste tests were rated acceptable or better; 'Floralina' and 'Mountain Fresh' received a higher percentage of "taste great" responses than the other cultivars tested.

Acknowledgments

The authors would especially like to thank Kay Oakley, Ghee Ching, Curtis Gregory, Doris Cox, and Dave Lowry for their hard work and generous assistance with these trials.

Special thanks to Elizabeth Griffin and Andie Rowell for help with the consumer taste tests and to Dr. Robert Shewfelt, professor of food science at the University of Georgia, for his very helpful suggestions on how to best conduct these tests.

An Introduction to Echinacea Production in Kentucky

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Echinacea, or purple coneflower, is a herbaceous perennial plant native to Kentucky. There is increasing interest in this plant for herbal and pharmaceutical markets because of its medicinal qualities. It is known to increase the immune system's ability to fight against colds and allergies. Its medicinal components, phenolic compounds, are found in highest concentrations in the roots.

Coneflowers grow 2½ to 5 ft tall, with large purple ray flowers and spiny disc flowers in the center, giving the appearance of a "cone." Growers usually harvest in the fall after three to four years of growth to ensure a large quantity of roots. *Echinacea purpurea* and *Echinacea angustifolia* are the most popular species used in herbal markets.

Starting Seeds

Seeds must receive a period of cold stratification to ensure proper germination. They are placed in a moist towel and put in a refrigerator (40° F) for two to eight weeks, depending on the species. The ease of germination also depends upon the species. When germinated in a warm, moist environment, *Echinacea purpurea* is the easiest to grow, whereas *Echinacea angustifolia* is the most difficult. Seeds can be directly sown into open trays and transplanted to cell packs (24-48/tray) or sown into plug trays.

Transplanting

It is important to plant in the field in the spring when the weather is cool and the soil is moist. Growth differs considerably if that planting window is missed. In our trials, plants were transplanted into double rows 8 in. apart on raised beds. Raised beds help with drainage and allow easier harvest of the roots at the end of the season. Drip irrigation was installed, and plants were hand weeded. Only a mild herbicide was used between the rows.

Current Research

There is little information available that describes how to produce a crop of Echinacea that is high in yield and active ingredient content. We are growing Echinacea in different ways to determine the best way to produce a commercial crop. We are comparing simple pruning techniques, such as cutting back to the ground and removing flower buds, to determine the effects on biomass and active ingredient content. We are evaluating fertilizer additions and effects of trickle irrigation, hoping to find a way to increase the active ingredient content in the roots as well as increase biomass/yield.

We are also conducting a variety trial. There are 10 species/cultivars in the plot: *Echinacea angustifolia*, *E. pallida, E. paradoxa, E. tennesseensis, E. purpurea, E. purpurea* 'Magnus,' *E. purpurea* 'Clio,' *E. purpurea* 'White Swan,' *E. purpurea* 'Bravado,' *E. purpurea* 'Bright Star.' There is little information comparing the active ingredient content between species and cultivars. We are simply growing the plants and harvesting them after one and two years to compare the chemical content between the species. Results for our 1999 field trial were still being tabulated at the time of this writing.

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, which are located on the UK campus in Lexington and at the UK Research and Education Center in Princeton. Of the more than 4,000 plant specimens examined annually, approximately 5% are commercial fruit and vegetable plant specimens (1). Although there is no charge to growers for plant disease diagnosis at UK, the estimated direct annual expenditure to support diagnosis of fruit and vegetable specimens by the laboratory is $15,000, 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 that require consultation with UK faculty plant pathologists and horticulturists, 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.

After a relatively mild winter, the 1999 growing season in Kentucky was very dry. For the 26-week growing season (April 1 - October 1), 21 weeks received below normal rainfall and the rainfall deficit statewide averaged about 9 in. Some stations recorded deficits of over 13 in., receiving less than half of the 25 in. of rain which would normally fall during the growing season. Although drought was a season-long problem, progressing from severe to extreme in the central and eastern regions of the state, the months of July, August, and September were especially dry; indeed, they were the driest reported in Kentucky for the past century. Exacerbating the drought, 18 of the 26 weeks of the growing season recorded above normal temperatures, and some weeks were as much as 8-10 degrees (F) above normal.

Thus, in most locations, much of the 1999 growing season was not very favorable for foliar diseases of fruits and vegetables. Nevertheless, in certain areas such as moist river bottom sites or fields with overhead irrigation, foliar diseases were still common. Vascular wilts and some root decay diseases were made worse by the drought stress. Because of the dry weather, new growers of fruits and vegetables may get the impression that foliar diseases caused by bacteria and fungi are not much of a problem. Similarly, experienced growers trying new cropping or disease management systems may overestimate the merits of the new approaches. We would urge those growers not to become complacent in their foliar disease control efforts, because this year was not typical.

Results and Discussion

Tree fruit diseases

Although spring weather in Kentucky was not particularly rainy, the brief showers that did occur were well timed for the cedar rusts (*Gymnosporangium juniperi-virginianae, G. clavipes, G. globosum*). Rust-susceptible apples showed significant cedar-apple rust leaf spots and calyx-end fruit infections caused by cedar-quince rust. Showers during bloom were sufficient to initiate primary infections of fire blight in most parts of the state; considerable secondary shoot infections ensued on susceptible apples and pears. Lack of continued rain and long leaf wetness periods reduced the incidence and severity of apple scab (*Venturia inaequalis*); fruit diseases such as 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. The "Show-Me" and "Spectrum Watchdog" orchard weather stations with leaf wetness monitors used for plant disease management were used by a Scott County grower in the apple IPM program and for fruit defects research at the UK Horticultural Research Farm in Lexington.

Small fruit diseases

Grape black rot (*Guignardia bidwellii*) was prevalent early in the season. Strawberry leaf spot (*Mycosphaerella fragariae*) occurred early, and black root rot (*Rhizoctonia solani*) occurred later, enhancing vulnerability of strawberries to drought. Systemic orange rust (*Gymnoconia nitens*) was damaging to blackberries in some locations.

Vegetable diseases

TMV (Tomato Mosaic Virus) and INSV (Impatiens Necrotic Spot Virus) were found in tomato and pepper transplants. Usually, the virus came from other plants being grown in the same greenhouse. For example, TMV came from "heirloom" varieties being grown for transplants in the same house as the commercial tomato varieties. Similarly, INSV developed as a result of vegetable transplants being produced in the same greenhouse with virus-susceptible ornamental plants.

Tomatoes in commercial plantings were infected by bacterial canker (*Clavibacter michiganensis*) and some fungal diseases such as early blight (*Alternaria solani*), Septoria leaf spot

(*Septoria lycopersici*), and timber rot (*Sclerotinia sclerotiorum*). Gray mold (*Botrytis cinerea*) and leaf mold (*Cladosporium fulvum*) were observed on Kentucky greenhouse tomatoes.

Peppers developed bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria*), but less than in rainy seasons. Where used, resistant varieties have greatly reduced the disease potential.

Pumpkins and other cucurbits are becoming more popular in Kentucky, and their diseases continue to be economically important. Microdochium blight (*Microdochium* sp.) was found at serious levels. Powdery mildew, caused by two different fungi (*Sphaerotheca fuliginea* or *Erysiphe cichoracearum*), is serious every year. For the first time in Kentucky, the more common of the two fungi, *S. fuliginea,* was found to be resistant to Benlate; this occurrence is in addition to Bayleton resistance, which was already present. Downy mildew (*Pseudoperonospora cubensis*) was present in some fields in the fall. Fusarium (*Fusarium* sp.) fruit rots were a common but a difficult-to-diagnose problem this year.

Southern blight (*Sclerotium rolfsii*) was more commonly observed this year on vegetables such as beans, potatoes, pumpkins, and tomatoes. The laboratory has also uncovered several complex root and stem rots and wilt diseases involving the fungus *Fusarium* on peppers, pumpkins, tomatoes (and tobacco), especially where transplants were used.

Sweet corn bacterial top and stalk rot (*Erwinia chrysanthemi* pathovar. *zeae*) was found in some commercial fields.

The laboratory has been conducting a survey of the viruses infecting commercial vegetables in Kentucky for the past several years.

Using ELISA tests, a broad range of virus diseases were found. No new viruses were detected in 1999. 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 Bravo 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.

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 the laboratory often enough, or they are waiting until their disease problem has become well established. By that time it may be too late to do anything about the disease problem or in some cases, to correctly diagnose the sequence of diseases that may have led to the final outcome. Growers need to consult regularly 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 the need for accurate diagnosis of diseases of high-value crops. Growers can work with their agents to see that they get 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. 2000. Plant Diseases in Kentucky—Plant Disease Diagnostic Laboratory Summary, 1999. UK Department of Plant Pathology (in press).

Appendix A: Sources of Vegetable Seeds*

Code	Company Name and Address
AAS	All America Selection Trials, 1311 Butterfield Road, Suite 310, Downers Grove, IL 60515
AS/ASG	Asgrow Seed Co., 7000 Portage Rd., Kalamazoo, MI 49001
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. 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, 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
J	Jordon Seeds Inc., 6400 Upper Afton Rd., Woodbury, MN 55125
JS/JSS	Johnny's Selected Seeds, Foss Hill Road, Albion, MA 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, Ph: (800) 873-7333
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
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, Ph: (208) 322-7272, Fax: (208) 378-6625
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., 5-17919-B, Wauseon, OH 43567
S	Seeds Trust, P.O. Box 1048, Halley, ID 83333-1048
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	Territorial Seed Company, P.O. Box 157, Cottage Grove, OR 97424
TR	Territorial Seed Company, 20 Palmer Ave., Cottage Grove, OK 97424
TS	Tokita Seed Company, Ltd., Nakagawa, Omiya-shi, Saitama-ken 300, Japan
TW	Twilley Seeds Co. Inc., P.O. Box 65, Trevose, PA 19047
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

** 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.

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