NEW YORK FRUIT QUARTERLY

VOLUME 8 • NUMBER 2 • SUMMER 2000

Editorial

Strategic Planning Can Change the New York Apple Industry

This past winter, after discussing several partial alternatives, a decision was made to proceed with the development of a strategic plan for the entire New York apple industry. It is not sponsored by any one organization, although it has the support of the New York Apple Association, the NYS Horticultural Society, the NYS Department of Ag. and Markets and people at Cornell with critical expertise in the process. One key element was the promise of assistance from two Cornell faculty members. These are Dr. Bruce Anderson, who facilitated strategic planning for companies in 1999 with total sales of over $30 billion, and Dr. Jerry White who has worked for 22 years with the New York apple industry and has access to a wealth of data on the apple industry. We also appreciate the administrative support of Joan Willis at the NYAA, who has sent the meeting notices out accurately, efficiently and timely.

The economic system is ruthless in telling us we need to change. It takes resources (money) away from people who are not using them efficiently and gives them to the enterprises that are. However, it is not very good at telling us how we need to change. This is why we need strategic planning. By examining the strengths and weaknesses of the industry, and evaluating the threats and opportunities that are present, we can develop an action plan that will make better use of economic resources and be rewarded through increased financial returns to the industry.

In order to facilitate the process, a Task Force of 25 people came together for the first meeting on April 24. One very pleasant surprise was the very strong support from Commissioner Rudgers, who not only addressed the group, but also agreed to be Honorary Chair and participated in the entire meeting. The group reaffirmed the need to carry out the process and suggested that a series of regional meetings be held in all parts of the state to solicit input from the industry and to make everyone feel a part of the process. Five regional meetings were held, plus one statewide meeting for storage operators and marketers. Approximately 200 people participated in these meetings from a broad cross section of the industry. These were followed by the second meeting of the Task Force on June 28. This completed Phase I of the process. Phase II will include procuring additional information from groups that were not well represented in the initial meetings, such as consumers and growers and marketers from other states. Phase III will include drafting the plan and Phase IV will be developing the action plan to carry it out. Our target date for completion is March 1, 2001. Tentative plans call for presenting the completed plan to the industry at a forum in February.

One of the things that has made this process succeed so far is that everyone in the industry knows we have to make changes. If we don't, we'll get the same results we're getting now. This realization leads people to accept an imperfect process because "there's no way it can get any worse." I remember John F. Peters, the long time VP of procurement for Knouse Foods, saying it took 29 cents per bushel of apples in 1950 to get growers to give up their independence and work together to form that great organization. If we allow a little for inflation, we're back to 29 cents per bushel of apples again. One quote Dr. Jerry White picked up recently is that "farmers need to develop their interdependence in order to maintain their independence." Unfortunately it takes adversity to create a willingness to do this. However, if we can swallow our individual pride, and put our heads together, we can determine new courses of action that will be successful. That's good strategic planning!

George F. Lamont, Chair
NY Apple Industry Strategic
Planning Task Force

CONTENTS

ABOUT THE COVERS

Front cover: Fruit field days and equipment shows during the summer are excellent opportunities for growers to learn about the latest innovations in fruit growing. Don't miss the Cornell Fruit Field Day and Equipment Show, August 17, in Geneva, NY.

Back cover: A selection of grapes from the grape breeding program at Cornell. See the article by Tim Martinson on p.22.

NEW YORK FRUIT QUARTERLY
VOLUME 8 • NUMBER 2 • SUMMER 2000

This publication is a joint effort of the New York State Horticultural Society, Cornell University's New York State Agricultural Experiment Station at Geneva, and the New York State Apple Research and Development Program.

Editors:
Terence Robinson and Steve Hoying
Dept. of Horticultural Sciences
New York State Agricultural Experiment Station
Geneva, New York 14456-2227
Telephone: 315-787-2227
Fax: 315-787-2216
Advertising: Warren Smith: 914-255-1442

Trends In Apple Marketing and Impacts on NY Growers' Profitability

Gerald B. White
Department of Agricultural, Resource, and Managerial Economics, Cornell University, Ithaca, NY

New York apple growers are reeling from the financial impacts of several years of low returns. At the time of this writing, a group of industry leaders are developing a strategic plan for the state's apple industry. New York Congressmen Hinchey and Walsh have sponsored an amendment to the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Bill that would provide relief for "loss of markets." If passed by Congress and signed by the President, this legislation would provide $100 million to the U.S. apple industry to make payments to apple producers based on the grower's 1999 production of apples. On May 18, the International Trade Commission ruled unanimously that China's apple-juice concentrate imports were causing harm to the U.S. apple industry. This came on the heels of a ruling by the U.S. Department of Commerce on April 7 designed to put a stop to the devastating effects of China selling apple juice concentrate in the U.S. at prices significantly below their cost of production. The Commerce Department levied antidumping duties of 51.7 percent on most Chinese concentrate imports, but, from the growers' point of view, considerable damage had already been done to juice prices in the preceding crop year.

Changes in produce buying patterns threaten NY apple shelf space in major retail chain stores.

New York apple growers are reeling from the financial impacts of several years of low returns. These events point out that there is an international problem in which supplies of apples have grown faster than demand. Many in the New York industry are wondering if things will work themselves out and more favorable prices and markets will return. However, there appear to be even more fundamental problems than a temporary oversupply situation that call for a coordinated response by the New York industry.

These events point out that there is an international problem in which supplies of apples have grown at a faster rate than the demand. The world per capita consumption of apples has been static for some time. Apple growers from New Zealand, the European Union, and Washington State are also feeling the effects of low returns.

When the inevitable shakeout of farms and other apple marketing and processing firms occurs, many in the industry are wondering if the situation will result in more favorable prices and markets for New York apples. A positive response to this question is little consolation because oversupply situations can take several years to work themselves out with a perennial crop such as apples, given the lag of at least two or three years between investment in new plantings and the impact of the fruit from these plantings on markets. However, even more fundamental problems than a temporary oversupply situation call for a coordinated response by the New York apple industry. This article examines three aspects of the

current environment for apple markets: (1) changes in the retail sector and their potential impacts on produce suppliers; (2) trends in apple production and prices in Washington and New York states, and, finally, (3) the confluent effects of these changes as demonstrated by trends in farm financial performance on a selected group of New York fruit farms. Specifically, the trends detailed in the Western New York Fruit Farm Business Summary for the 20-year period ending with the 1998 crop year are reviewed.

The New Dynamics of Produce Buying and Selling

Research by McLaughlin et al. (1999), in the Food Industry Management Program at Cornell has demonstrated the fast-paced changes in the produce industry. This research, funded by the Produce Marketing Association, developed performance benchmarks for the fresh produce industry. Questionnaires were completed and returned from produce executives and managers from 56 firms that ranged in size from single-store retailers to the very largest chain stores with multi-billion dollars in sales. The results document changes in key areas from the past (1994) to the then current (1999) and projected future (2004).

Sources over time. The most important source of produce purchase is direct from the grower/shipper, which is projected to account for just over half of purchases in 2004. The importance of this source increased from 36 percent of purchases in 1994 to 43 percent of purchases in 1999. Produce wholesalers, which accounted for about a third of retailers' produce purchases in 1999, are decreasing in importance, as are brokers. Brokers which accounted for 18 percent of retailers' purchases in 1999, are projected to decrease to a 13.5 percent share in 2004. New York shippers now heavily rely on brokers and wholesalers to get their fruit into retail stores.

Spot buying. Most produce buyers occasionally rely on the so-called "spot" market for produce procurement to balance supply or take advantage of attractive prices in an over-supply situation. Respondents reported that they projected "spot buying" to be about 10 percent of their purchases in 2004, down from 13 percent in 1999 and 17 percent in 1994. New York shippers currently depend heavily on the less formalized spot purchasing from chain buyers.

Contracts. Produce purchased through contracts is projected to account for an increasing share of retailers' purchases. In 2004, 56 percent of the respondents expect to purchase more than one-fourth of their produce through contracts. In 1994, only two percent of firms contracted for such a large percentage of their purchases. Contracts are not yet an important aspect of New York apple sales, but there is no reason to believe that they won't be much more important in marketing apples in the future.

Concentration. It is well known that the retailing food sector is becoming much more concentrated. This is even more important when, as this research shows, the largest retailers (in terms of total sales) are relying more on their top 10 suppliers. Smaller retailers' purchasing patterns are not changing significantly. For those retailers with less than $300 million in sales, about three-fourths of their produce purchases were expected to remain with their top 10 suppliers. However, the largest chains (over $1.5 billion in sales) exhibited a pattern of increasing reliance on their top 10 suppliers, from about half of purchases in 1994 to nearly three-fourths of purchases projected in 2004.

Due to its fragmented structure, the New York apple industry is particularly poorly equipped to deal with these changes in produce buying. On the other hand, our major competitor, Washington State, has been in a process of completing mergers, consolidations, and joint ventures. This consolidation has resulted in a growing concentration of suppliers to respond to the trend of increasing concentration in the retail sector. The pace of change accelerated in 1994 such that as of the 1997-1998 crop year, about 57 percent of sales of Washington apples were handled by the top 20 shippers and 38 percent by the top 10 shippers (average size=3 million bushels). Several significant mergers have occurred since the time these data were collected.

Bottom line. The concentration in retailing and the more organized procurement methods being used, featuring less spot buying, more contracting, and a growing role for the largest produce suppliers, are trends that pose a significant threat to the New York industry. McLaughlin and associates suggest several potential strategic responses which grower/shippers might consider: (1) expand control by horizontal or vertical integration, (2) develop new products or distribution methods, (3) undertake demand expansion programs, or (4) adopt cost reducing technologies. The great need for strategic action by the New York industry, in light of these changes, emphasizes that the nature of the industry's strategic planning process that began in April is both crucial and time-sensitive.

Labor is the single largest expense in growing apples.

Trends in Apple Production and Prices: Washington and New York

Production. The production trend in Washington is shown in Figure 1. Production in Washington State in the early 1980s ranged between 60 million and about 80 million bushels. However, in 1987, Washington's production skyrocketed to 119 million bushels, and reached nearly 140 million by 1994. Since that time, crops of 120 to 140 million bushels are the norm for Washington. Over the period 1980 to 1999, the growth in Washington's production trend has averaged about 4.2 percent.

Production growth in New York, on the other hand, has been much more stable, fluctuating around 25 million bushels (Figure 2). There has been a slight upward trend averaging less than one percent a year. The upward trend no doubt was heavily influenced by the huge 1999 crop of 30 million bushels, the largest crop in New York since 1926.

Prices. Washington fresh apple prices (packing house door equivalent) are shown in Figure 3 (National Agricultural Statistics Service, USDA). Prices since 1981 ranged from a low of 10.4 cents per pound with the then record crop of 1987 to as high as 26.3 cents in 1991. The an-

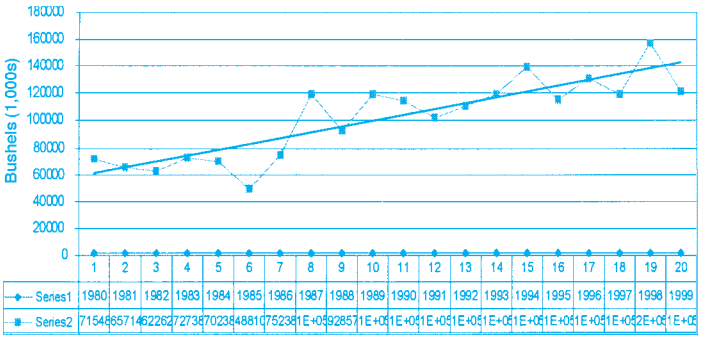


Figure 1. WA Apple Production 1980-99 (1,000 Bu.)

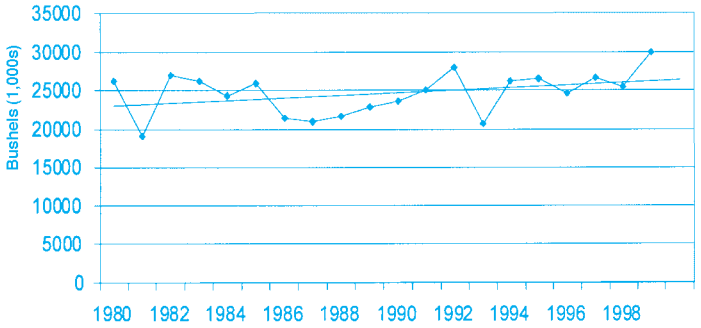


Figure 2. NY Apple Production 1980-99 (1,000 Bu.)

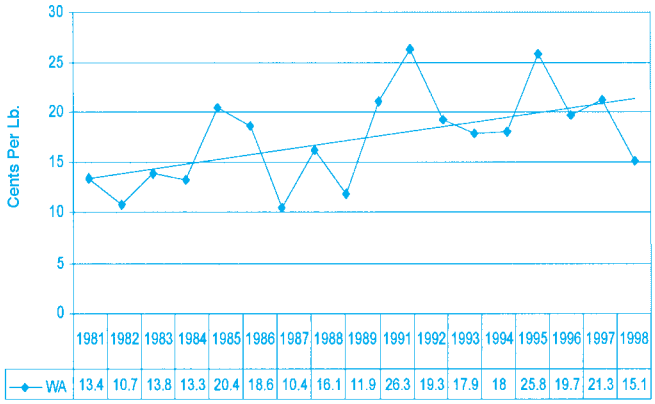


Figure 3. WA Fresh Apple Prices (USDA)

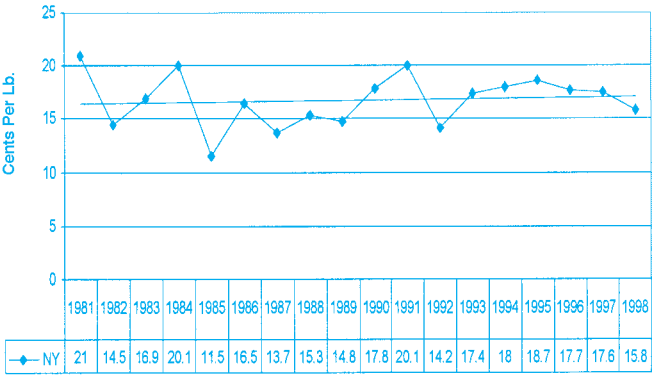


Figure 4. NY Fresh Apple Prices (USDA)

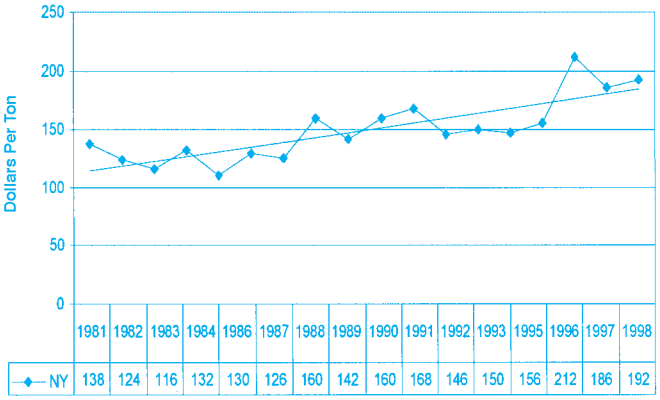


Figure 5. Canning Apple Prices in NY, 1981-98

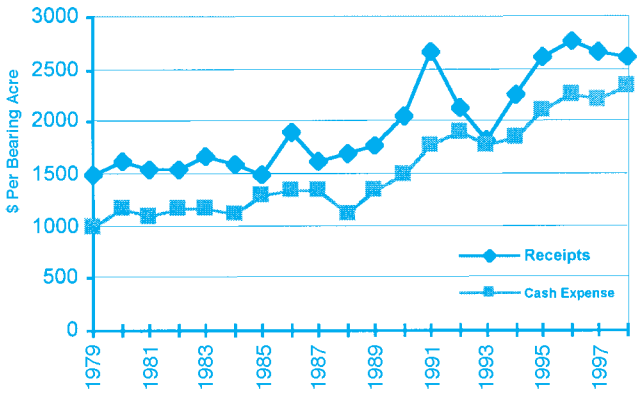


Figure 6. Receipts and Cash Expenses per Bearing Acre

nual trend of the price increase was 2.7 percent.

New York fresh apple prices are shown in Figure 4 (National Agricultural Statistics Service, USDA). Prices ranged from 11.5 cents in 1985 to 20.1 cents in 1984 and again in the sterling 1991 year when New York growers were blessed with a very profitable year. (Note: Due to a change in the way NASS calculated fresh apple prices, prices received in years after 1985 are not directly comparable to prices of previous years). Since 1986, the trend of prices has been upward at 1.1 percent annually.

Processing is still important to New York growers, particularly in Western New York. Although more attention is now placed on fresh production, the trend in prices for canned apples (Figure 5) (National Agricultural Statistics Service, USDA) is growing at an annual rate of 2.7 percent. Processing accounts for about 55 percent of the New York crop utilization. Canned apples represent the most important processing use, accounting for about 7 million bushels annually in recent years. Fresh utilization accounts for about 11.5 million bushels annually.

Bottom line. These trends graphically illustrate that Washington is gaining a percentage share of the national market, while New York is losing with production increasing more slowly than the national crop. The loss of national share is no doubt linked to the returns side of the equation in which Washington prices for fresh apples increased at a higher rate than the New York price.

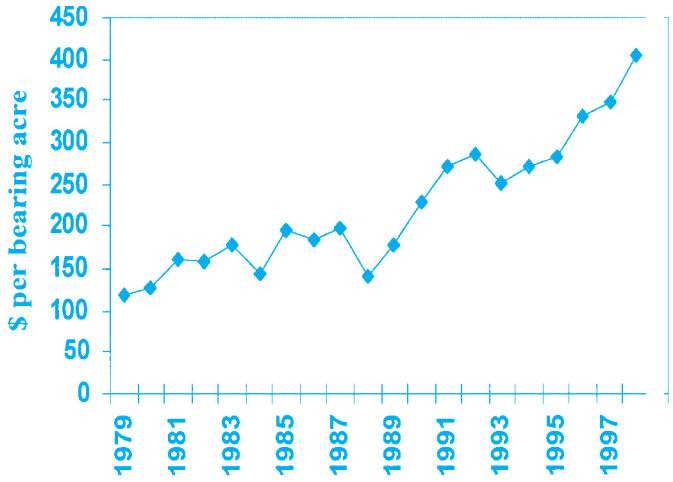


Figure 7. Spray Exposure per Bearing Acre.

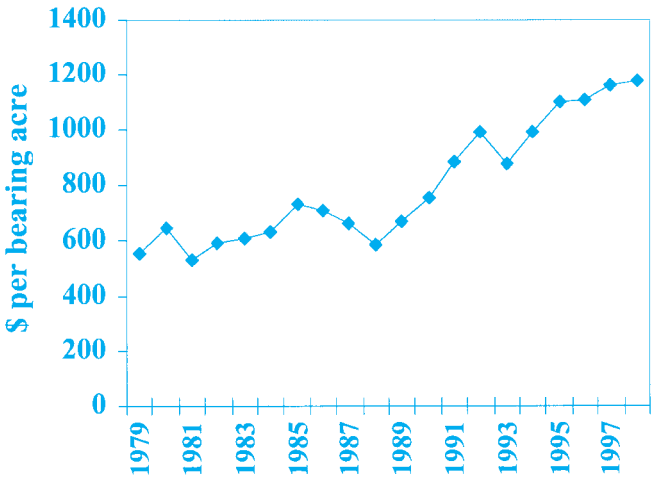


Figure 8. Labor Expenses per Bearing Acre.

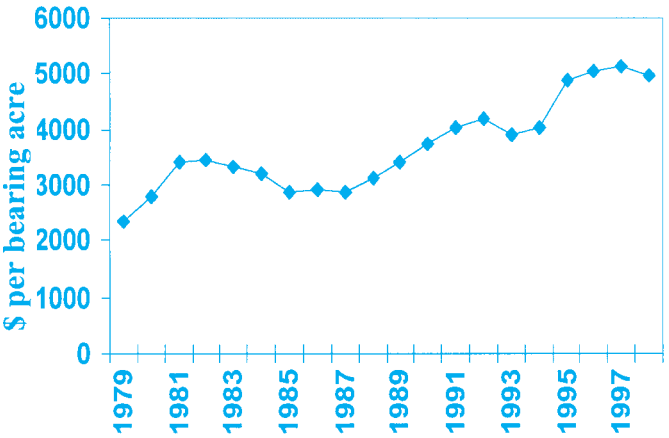


Figure 9. Capital Investment per Bearing Acre.

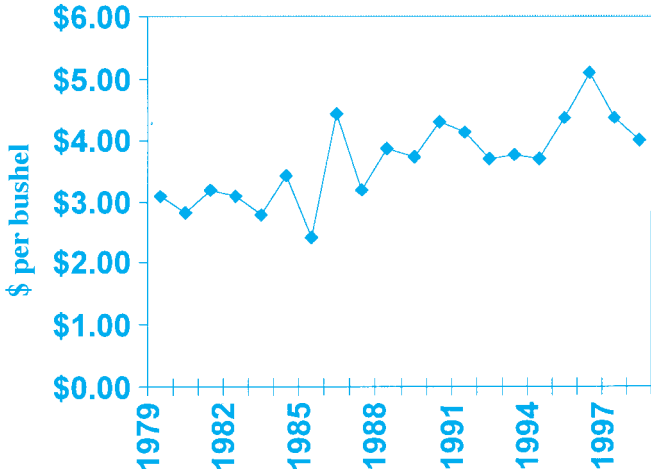


Figure 10. Apple Price per Bushel.

Trends in the Western New York Fruit Farm Business Summary Farms

For the past 20 consecutive years (representing crop years 1979–1998), the Department of Agricultural Economics at Cornell (more recently, the Department of Agricultural, Resource, and Managerial Economics) has participated in a joint project with county or area extension agents to collect data from fruit farms in Western New York, primarily from Niagara, Orleans, and Wayne counties. Agents who were involved in the data collection process were Dick Pease from Niagara County (1979-1981) and Alison DeMarree of the Lake Ontario Fruit Team (1982-1998). The number of farms involved varied from 10 in the early years to as many as 24 in the 1991 crop year. In the most recent years, participating farms have numbered about 18 or 19 and accounted for over eight percent of the apples produced in the state. Typically these farms grow other fruit crops, especially cherries and peaches, but over 80 percent of total cash receipts are from apples. Packing and selling expenses are not included in costs; therefore the receipts and expenses are indicative of actual orchard operations. For the most recent study, refer to the Fruit Farm Business Summary, Lake Ontario Region, 1998" (White, et al. 1999).

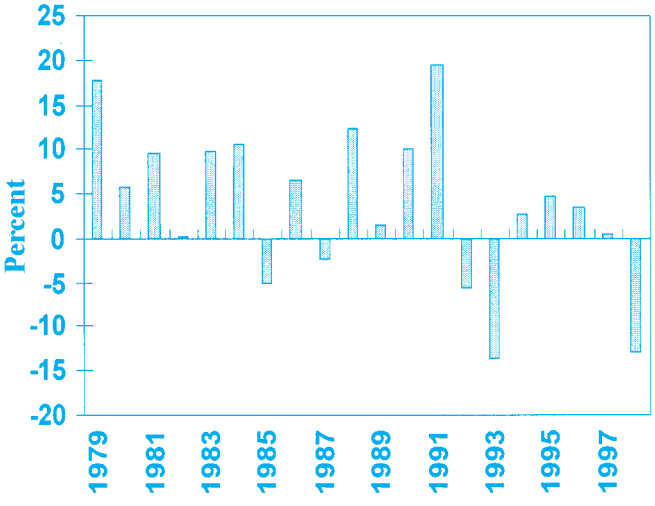


Figure 11. Percent Return on equity

These data were analyzed for various measures of financial performance and production efficiency. A publication is provided each year for the use of the participating growers and others in the industry to help managers improve the financial performance of their businesses from the use of historical farm data and the application of modern farm business management techniques. Given the current interest and concern about fruit farm profitability and viability, these analyses provide a wealth of information for assessing the current problems in the industry. They are also useful for analyzing trends that are occurring on the state's fruit farms as the new dynamics of produce buying and selling and the impact of Washington's increasing dominance of the U.S. industry are felt in apple markets.

Receipts per bearing acre. Receipts per bearing acre (Figure 6) on these Western New York farms varied from $1,508 in the early '80s to as high as $2,772 in 1996. This is an important measure of financial performance since it is an indication of the productivity of the key asset in fruit farming (the bearing acre) that captures both yield and price in the same indicator. Over the 20-year period, this variable showed an annual increasing trend of 3.4 percent per year.

Cash expenses per bearing acre. Cash expenses per bearing acre (Figure 6) averaged just below $1,000 in 1979 and reached $2,343 in 1998. The annual rate of the increasing trend was 4.6 percent. The rapid increase of expenses relative to receipts indicates the classic "cost-price squeeze" that is common in agriculture, and not exclusively in fruit farming. It means that farms are often pressed into operating more acreage in order to maintain the same level of income. In fact, farms included in this analysis had an increase of bearing acreage per farm from about 100 acres in the early years of the summary to about 240 in the latter. This cannot be assumed to be representative of the industry since some farms dropped out of the study while other (mostly larger) farms were added over the 20-year period.

Spray expense per bearing acre. Spray expense per bearing acre was the fastest growing component of total costs on these fruit farms (Figure 7). It is the second largest expense category (behind labor), and its rate of increase was about 5.6 percent per year. Spray expense per bearing acre is the product of pounds of spray material used times the price of material. While we cannot say conclusively, it appears that the price of material is the driving factor in the cost increase. With the rapid infusion of IPM techniques in the late '70s and early '80s, growers generally were able to reduce the number of applications and sometimes material per application. On the other hand, more expensive, and usually more "environmentally friendly" compounds, were used

Labor expense per bearing acre. Labor comprises the largest component of total cost in fruit farming. In the business summary analysis, we factored in a charge for the owner's labor and other unpaid family labor as well a charge for cash wages paid so that the total labor input is measured, not only cash wages. In the most recent year, the owners labor was added at a cost of $1,600 per month. The total labor input for owners', other unpaid family labor and wages for paid workers amounted to $1,175 in 1998 (Figure 8). This factor increased at the rate of about 4.3 percent per year.

Capital investment per bearing acre. This factor measures capital used in the business. Capital includes the value of land and orchards, buildings, machinery and equipment, and inventory in crops and supplies. In 1979, capital investment per bearing acre was $2,340 (Figure 9). In the last years of the study, it exceeded $5,000 per bearing acre—a two-fold increase. The average rate of increase for the 20-year period was about 3.4 percent.

Apple price per bushel. Price in this case is a "blend" price, or a combination of prices of fresh and processed fruit. It is the total receipts from the sale of apples divided by the number of bushels of apple sold. The lowest price was $2.42 per bushel in 1985 (Figure 10). The highest price realized was $5.08 in 1996. Prices received increased at a 2.3 percent rate over the period of the study, well below the 4.6 average annual increase in expenses.

Return on equity. Return on equity is the measure of profitability used in this article. It indicates the return that the grower received on his or her own capital used in the business. This return might be compared against other opportunity returns (certificates of deposit, bonds, or the stock market) to see how growers are faring by committing their capital to the fruit business. We include the value for appreciation of assets in computing this measure of profitability. The mean return on assets has been a modest 3.8 percent over the 20 years, well below that of most other investments.

Returns on equity have varied from a low of –13.8 percent in 1993 (when New York growers were hit by a combination of a short crop and low prices) to a high of 19.4 percent in the sterling year of 1991 when New York had high production, a quality crop, and high prices (Figure 11). Over the 20 years, there have been five years of negative returns and five years of high returns when the return on equity was 10 percent or higher.

The disturbing aspect of this measure is that three of the negative return years occurred in the last seven years. (Our best estimates are that 1999 will be another year of negative return on equity.) The trend line for return on equity, although with a lot of variability around it, is declining at about 18 percent a year. This measure is indicative of the poor financial condition of many of the state's fruit farms at the present time.

Conclusions

This article has discussed and documented the changes in produce marketing, the increasing competition from our major competitor (Washington State), and the worsening of financial conditions on fruit farms in New York State. We have seen that New York growers receive less for their fruit than their major competitor, and that the gap is widening. Growers who have been in the business for a number of years realize that this is a cyclical industry; there are periods of both high and low returns. A fair question is this: Is the current period of unusually low returns something that will correct itself as the shakeout from the industry occurs? We know that growers in New Zealand, the Netherlands, as well as in Washington State and New York, are experiencing difficult times. Another question is, when excess capacity has been removed from the system, will profits improve?

In the author's opinion, after a shakeout occurs, New York growers will still be in a weak competitive position, mainly due to fundamental problems in the fragmented nature of the state's industry. We are competing against increasingly concentrated sellers in marketing our fruit to bigger buyers who have more formalized buying practices, and are more demanding of quality and service than they were in the past. Our state's industry seems poorly equipped to deal with these market realities. The answer may not necessarily be greater concentration, although that seems to be the most logical solution. But certainly some major changes in the way fruit is marketed appear to be necessary if the state is to maintain a major presence in the retail trade of apples over the

longer term. It appears to be a critical time for the apple industry to collectively develop a strategic plan to address the fragmented nature of our industry.

References

McLaughlin, E.W., K. Park, D. J. Perosio, and G. M. Green. 1999. The new dynamics of produce buying and selling. FreshTrack 1999, Food Industry Management, Cornell University, Ithaca, NY 14853. 68 pp.

National Agricultural Statistics Service, United States Department of Agriculture, Noncitrus Fruits and Nuts Final Report, various issues, 1982–1999.

White, G.B., A.M. DeMarree, and L.D. Putnam. 1999. Fruit farm business summary, Lake Ontario Region, 1998. E.B. 99-12, Department of Agricultural, Resource, and Managerial Economics, Cornell University, Ithaca, NY 14853. 27 pp.

Gerald White is a professor in the Department of Agricultural Resource and Managerial Economics at Cornell University. He conducts extension programs and applied research in management and marketing of horticultural crops. He also teaches a course in strategic market planning for horticultural crops.

Apples: An Important Source of Antioxidants in the American Diet

C. Y. Lee and N. L. Smith

Department of Food Science and Technology, New York State Agricultural Experiment Station, Cornell University, Geneva, NY 14456

This work supported in part by the New York Apple Research and Development Program and New York Apple Research Association.

Apples contain a significant amount of phytochemicals. Apple skins are a rich source of quercetin which is known to have strong antioxidant and anticancer activities. Different apple cultivars exhibit differing amounts of phytochemicals and antioxidant activity. Based on the high antioxidant activity of apples, Americans should consume more apples, or at least one apple a day, to increase the total antioxidant content of their diet.

Over the past two decades, many scientists have demonstrated that diet plays an important role in the morbidity and mortality associated with the major diseases in the United States, such as cardiovascular disease, cancer, hypertension and obesity. Cancer and cardiovascular disease combined account for about 70 percent of all U.S. deaths. Scientists estimate that one-third of all cancer cases and one-half of cardiovascular diseases and hypertension can be attributed to diet (Buring and Hennekens, 1995).

The Health Benefits of Antioxidants and Phytochemicals

Antioxidants are substances or compounds that quench or stabilize free radicals, so they can prevent the oxidation of other molecules. Free radicals, formed in the ordinary process of oxygen metabolism, are very reactive chemical species that could damage cellular machinery. Abundant scientific evidence indicates that certain naturally occurring non-nutritive chemical components, commonly referred to as phytochemicals, nutraceuticals, or functional compounds, have antioxidant activity. Phytochemicals are found in fruits, vegetables, herbs, spices, and cereals, and prevent or reduce the risk of some chronic diseases such as cancers and cardiovascular disease. Polyphenols are one of the phytochemical groups whose important biochemical properties include antioxidant activity. For example, some polyphenols scavenge free radicals, e.g. superoxide ions, singlet oxygen and lipid peroxyl radicals. Polyphenols inhibit lipoxygenase and cyclo-oxygenase (Laughton et al., 1991) as well as lipid peroxidation and also have diverse effects on immune and inflammatory cell functions (Decharneux et al., 1992). Some polyphenols also display antihemolytic activities, inhibit oxidation of low-density lipoprotein (LDL) by macrophages, and prevent cytotoxicity of oxidized LDL on lymphoid cell lines (Negre-Salvayre and Salvayre, 1992). In addition, some polyphenols, such as flavonoids, have been reported to affect capillary permeability, cellular secretory processes, cell membrane receptors, and carriers. Mutagenic, antiviral, antibacterial, and antifungal properties of flavonoids have also been demonstrated. Flavonoids in regu-

Apples are high in antioxidants which help explain why “an apple a day keeps the doctor away.”

larly consumed foods such as tea, onions, and red wine may reduce the risk of coronary heart disease in elderly men (Hertog et al., 1993).

There is also a large body of evidence that shows that supplementing the diet with micronutrients has positive health benefits. Many of these micronutrients can be derived from plants. In addition, plant macro components such as fiber may reduce cancers of the colon and other tissues. In 1982, the National Research Council advised that cancer risk might be reduced by increasing the consumption of carotene-rich fruits and cruciferae family vegetables. That recommendation has been substantiated by strong epidemiological evidence including a recent study that demonstrated that persons with a low fruit and vegetable intake experienced twice the risk of cancer (Block et al., 1992). Some polyphenols have been shown to exhibit synergistic interactions with other nutrients. Therefore, phytochemicals will play an increasingly important role in optimal nutrition as this new era in the food and nutritional sciences develops. As consumers become more aware of the anticancer potential of some plant foods, the demand will grow for natural and processed foods that manifest these health benefits.

TABLE 1

Antioxidant Activity of Various NY Apple Cultivars

Variety	Antioxidant Activity* (%)	Total Phenolics (mg/100g)
Fuji	98.3	101.9
Spartan	81.5	83.6
Pioneer McIntosh	76.0	106.7
Delicious	75.7	123.8
Liberty	72.5	101.0
Granny Smith	72.1	134.5
Jonathan	72.0	108.1
Northern Spy	61.5	137.6
Cox Orange Pippin	58.9	128.9
Rome Spuree	57.2	107.4
NY 674	51.9	85.8
Freedom	51.2	123.4
Idared	50.9	78.1
Red Cort	49.4	86.8
Gala	47.7	85.2
RI Greening	44.6	132.7
Crispin	40.9	83.7
Rubinette	34.5	88.2
Jonagold	24.2	139.7
Jonamac	19.4	82.4
Empire	<10	50.9
Golden Delicious	<10	82.2
Gingergold	<10	64.9

*Antioxidant activity of 66 mg of apple tissue relative to that of 30 ppm α-tocopherol.

TABLE 2

Concentration of phenolics in fresh apples grown in NY State.

Penolics	Golden Delicious	Cortland	Monroe	R.I. Greening	Empire	NY674	*Average*
	(mg/100g apple tissue with skins)						
Chlorogenic acid	8.48	5.36	10.08	14.28	11.52	4.40	*9.02*
Epicatechin	7.12	8.32	10.72	19.16	2.28	4.32	*8.65*
Procyanidin B2	6.28	11.32	8.32	21.68	3.44	5.04	*9.34*
Quercetin glycosides							
arabinoside	2.16	2.40	4.44	2.88	2.76	1.56	
xyloside	1.68	1.08	2.28	1.92	2.16	1.20	
glucoside	2.40	1.56	2.40	12.0	2.40	0.36	*15.84*
galactoside	4.20	3.36	4.80	4.32	4.20	1.92	
hamnoside	3.84	2.28	3.12	4.08	3.84	2.40	
Phloretin glycosides							
glucoside	1.80	1.44	2.40	2.08	2.80	1.84	
xyloglucoside	1.92	3.20	4.92	5.88	1.72	3.56	*16.78*
Total	**39.88**	**40.32**	**53.48**	**77.48**	**37.12**	**26.60**	***59.63***

Various stone fruits and berries are reported to contain significant amounts of phytochemicals. In apples, there are several classes of polyphenols; flavonol glycosides, phenolic acids, catechins, dihydrochalcones, and procyanidins. Most of these compounds are known to have antioxidant activity. In less significant amounts, glutathione and ascorbic acid are the other antioxidants that occur in apples.

Antioxidant Activity of Apples

Apples are one of the major fruits consumed by Americans. Among fresh fruits consumed in 1996, bananas ranked first (28 pounds), and apples second (19.3 pounds)—more than oranges, grapes, or grapefruits. When fresh and processed products are combined, the per capita consumption of apples (47 pounds) exceeds that of bananas. Therefore, the contribution of apples to antioxidant activity in the American diet could be significant. Our main interests in this research were to evaluate the antioxidant activity in various apple cultivars and their antioxidant contribution to the American diet. The importance of the antioxidant activity measurement is that it should measure total antioxidant activity derived from whole fresh apples as they are consumed by consumers.

We analyzed antioxidant activity of apples based on coupled oxidation of linoleic acid and b-carotene and expressed the results as relative percent of 30 ppm α-tocopherol equivalent (100 percent). Flavonoids were extracted, isolated, and analyzed by an HPLC method developed in our laboratory and total phenolic contents were analyzed by the colorimetric method using the Folin-Ciocalteau reagent.

Table 1 shows the antioxidant activity and total phenolic content of various apple cultivars grown in New York State in 1997. There was a wide range of antioxidant activity among the 24 apple cultivars studied. Based on their antioxidant activity, the cultivars can be divided into three groups: the high activity group with more than 60 percent activity, the medium activity group with activity between 40–60 percent, and the low activity group with below 40 percent activity. Among the apple cultivars studied, well-known apple cultivars such as Fuji, McIntosh, Delicious, Granny Smith and Jonathan apples belong to the high activity group. Apple cultivars such as Idared, Gala, RI Greening and Crispin belong to the medium activity group. Jonagold, Empire and Golden Delicious apples are relatively low in antioxidant activity. The difference in antioxidant activity among various apple cultivars might be due to the difference in composition and concentration of phenolic compounds and also due to unknown synergistic effects among phenolics and other constituents. Apples, like other fruits, vary in chemical composition, even within the same variety. Some of the variables include maturity, location produced, agricultural practices, and other environmental factors. Therefore, we expect the antioxidant activity, as expressed in Table 1, to vary from year to year. We did observe variations in the 1998 and 1999 crops. It has been frequently reported that total phenolic content correlates with certain antioxidant activity. However, we found

that only 10 out of 24 apple cultivars showed some correlation (r^2=0.66) between antioxidant activity and the total phenolics content; other apple cultivars showed no direct correlation. This may be due to the fact that the total phenolic analysis using the Folin-Ciocalteau reagents includes many more compounds than just the biologically active flavonoids, and/or some phenolics that do not have the same antioxidant activity as others.

The composition and concentration of the major apple polyphenols observed in this study are shown in Table 2. Different apple cultivars showed different concentrations of polyphenols. The average concentrations of each phenolic are: phloretin glycosides, 16.78 mg; quercetin glycosides, 15.84 mg; procyanidin B2, 9.34 mg; chlorogenic acid, 9.02 mg; and epicatechin, 8.65 mg/100 g fresh apples. Most of these compounds are reported to have antioxidant activity. Among these, in particular, quercetin is the most powerful antioxidant. It was reported that quercetin reduces the carcinogenic activity of several food mutagens, inhibits enzymatic activities associated with several types of tumor cells, enhances the antiproliferative activity of the anticancer agents, and inhibits the growth of transformed tumorigenic cells (Leighton et al., 1992).

Consumption and Diet

Although there have been many scientific reports on the biological activity of selected phytochemicals in plant foods in recent years, these major questions still remain: Which plant foods consumed by Americans today contribute health benefits and how much? Which chemical constituents are responsible for such benefits? What kind of guidelines can we provide to consumers to help them select and consume the beneficial plant foods?

The nutritional value and health-related biological activity of various fruits and vegetables depend not only on the concentration of certain nutrients and phytochemicals but also on the amount of such foods consumed in the diet. No matter how high the concentration of a certain bioactive compound in a food, if the amount of consumption of that food is low, the contribution of the bioactive compound in the diet is negligible. For example, spinach and Brussels sprouts are relatively high in major vitamins and minerals, but their contribution to our diet is low because the amounts we consume are very small. On the other hand, tomatoes are relatively low in concentration of vitamins and minerals but make a major contribution to the U.S. diet because of large per capita consumption. Likewise, apple phenolics may contribute significantly to our diet. Among the major fresh fruits consumed in the U. S., per capita consumption of banana is 28 pounds, apples 19.3 pounds, oranges 12.8 pounds, followed by grapes (6.9 pounds), grapefruit (5.8 pounds), strawberries (4.4 pounds), peaches (4.3 pounds), and pears (3.1 pounds). For a rough estimate, if we consider per capita consumption of fresh and processed apples as 47 pounds, the actual antioxidant contribution of apples exceeds that of any other major fruit in the American diet.

If we eat one apple (approximately 150 g) each day, we may be able to get about 1 g of polyphenols with a significant amount of healthy antioxidant activity. The daily human consumption of polyphenols in the average diet has been estimated to be about 1 g. Since we do not yet know the daily antioxidant requirement, we have to be prudent before drawing any conclusions. However, the evidence shown here is that apples contain important antioxidants such as quercetin that exhibits significantly high antioxidant activity. Since quercetins are mainly located in apple skins, consumption of apples with skins is highly desirable in order to maximize apple antioxidant activity. We are in the process of elucidating the anticancer activity of fresh apples.

C. Y. Lee is a professor of food chemistry in the Food Science & Technology Department, at the New York State Agricultural Experiment Station in Geneva. Nancy Smith is a research support specialist who works with Dr. Lee. A portion of this report was presented at the 1998 Annual Meeting of Institute of Food Technologists at Atlanta, Georgia.

References

Block, G., Patterson, B., and Subar, A. 1992. Fruit, vegetables, and cancer prevention: A review of the epidemiological evidence. Nutri. Cancer 18:1-29.

Buring, J. E. and Henneckens, G. H. 1995. Beta-carotene and cancer prevention. J. Cell. Biochem. Suppl. 22:226-230.

Decharneux, T., Dubois, F., Beauloye, C., Warriaux-de Coninck, S., Wattiaux, R. 1992. Effect of various flavonoids on lysosomes subjected to an oxidative or an osmotic stress. Biochem. Pharmacol. 44:1243-1248.

Hertog, M. G. L., Feskens, E., Hollman, P. C. H., Katan, M. B., Kromhout, D. 1993. Dietary antioxidant flavonoids and risk of coronary heart disease: the Zutphen elderly study. Lancet, 342:1007-1011.

Laughton, M. J., Evans, P. E., Moroney, M. A., Hoult, J. R. S., Halliwell, B. 1991. Inhibition of mammalian 5-lipoxygenase and cyclo-oxygenase by flavonoids and phenolic dietary additives. Biochem. Pharmacol. 42:1673-1681.

Leighton, T., Ginther, C., Fluss, L., Harter, W. K., Cansado, J., Notario, V. 1992. Molecular characterization of quercetin and quercetin glycosides in *Alliium* vegetables. In *Phenolic Compounds in Foods and Their Effects on Health II*; In: Huang, M. T., Ho, C. T., Lee, C. Y. Eds.; American Chemical Society Symposium Series 507; Washington DC; pp 220-238.

Miller, N. J., Diplock, A. T., Rice-Evans, C. A. 1995. Evaluation of the total antioxidant activity as a marker of the deterioration of apple juice on storage. J. Agric. Food Chem. 43:1794-1801.

Negre-Salvayre, A., Salvayre, R. 1992. Quercetin prevents the cytotoxicity of oxidized LDL on lymphoid cell lines. Free Radical Biol. Med. 12:101-106.

The Mission of the New York State Horticultural Society is to Educate, Promote, and Protect the New York Fruit Industry.

See page 30 for information on becoming a member or a sponsor of the NYSHS and help support this mission.

Orchard Storm Damage Recovery

J. R. Schupp[1], R. P. Marini[2] and J. A. Barden[2]

[1] Dept. of Hort. Sciences, Hudson Valley Lab, NY State Agricultural Experiment Station, Cornell University, Highland, NY 12528

[2] Dept. of Horticulture, Virginia Polytechnic Institute and State University, Blacksburg ,VA

In early September, 1999, Hurricane Floyd came up the East Coast and hit the Hudson Valley and lower Champlain Valley with strong winds from the north. The storm tipped over many trees right before harvest. A similar catastrophe hit the Western New York apple industry on Labor Day, 1998. Although it is very discouraging to see a once beautiful orchard that has suffered damage in a windstorm, don't give up. Propping storm-tipped trees has been shown to successfully salvage the damaged trees.

Orchards in Eastern New York occasionally suffer damage from hurricanes that have deteriorated into tropical storms. Likewise orchards in western New York may experience damage from severe windstorms that originate in the Great Lakes. Such severe storms are not frequent or predictable; consequently there has been no research on how to treat damaged trees after a storm. All the information available concerning the susceptibility of fruit trees to wind storms and how injured trees should be treated following a storm is based upon orchard observations.

A point that needs to be emphasized is that apple trees can recover from wind damage very well. In 1991, Hurricane Bob hit Southern Maine in late August. Following the storm, 100 trees each of 12-year-old McIntosh/M.7 and spur Delicious/M.7 were evaluated. Twenty-six McIntosh trees were knocked over and were propped up; one subsequently died. Forty-six Delicious trees required propping and 11 subsequently died. Of the trees that died, all did so within a year after the storm.

Eight years after the hurricane, the reduction in growth for those trees that reestablished was less than 10 percent compared to undamaged trees in both varieties. The greater number of tipped trees and higher mortality of Delicious may have been due to the fact that spur Delicious trees tend to have fewer lateral roots. Despite the greater damage to Delicious, though, the extent of recovery was the same as for McIntosh. Trees that die do so soon after the damage occurs; trees that survive recover quite well, despite the extent of the damage to the root system. Thus, it pays to salvage storm-damaged orchards.

The critical step in getting the orchard on the road to recovery is regenerating new roots to replace those broken off in the storm. This article describes the steps a grower can take to hasten recovery of storm-damaged orchards.

Our recommendation is to upritgh the trees as soon as possible. Speed is favored over permanence. Root regeneration begins immediately after the damage occurs, and is critical to re-establishing good anchorage. A notched 2X4 board makes a quick, inexpensive prop. Hurricanes and tropical storms often occur just before or during the harvest season, when farm labor is focused on harvest. Consequently, growers often decide to upright their trees after harvest, which can be six or more weeks after the storm. The consequences of this long delay are thought to be detrimental.

Be careful to tamp the soil in and around the roots of propped trees to pre-

Hurricane damage to a block of spur Delicious trees in Virginia. Spur Delicious are especially prone to tipping over in high winds, but can be salvaged, given prompt care.

Keys to Recovery of Storm Damaged Trees

1. **Prop tipped trees promptly**
2. **Tamp the soil around the roots**
3. **Prune minimally following the storm**
4. **Apply B and N to soil to stimulate rooting**
5. **Irrigate to prevent soil moisture deficits**

vent pockets of air or water and possible early winter cold injury to exposed roots. Air pockets around the roots of storm-damaged trees can also provide good habitat for voles, so careful monitoring and vole control measures are advisable. Often the motion of the tree trunk in the wind has caused a cup to form at the base of the tree that fills with water. This cup should be filled with soil to prevent ice injury, which can lead to collar rot infection.

Trees with damaged root systems take up less water and are more sensitive to drought. Root growth stops when soils dry out. Extra care in preventing soil water deficits through careful monitoring and scheduling frequent irrigation, if needed, is warranted in the growing season following a storm.

Another recommendation frequently given after trees have been propped up is to prune the canopy severely to bring the canopy volume into balance with the reduced root volume. The benefit of severe pruning as a storm damage recovery practice has not been documented, and the opposite suggestion (minimal pruning) is also often given. The primary benefit of severe pruning may be to reduce the potential for cropping in the season following storm damage. The presence of fruit has been shown to dramatically reduce root regeneration. Our present recommendation is to prune the injured trees minimally during the dormant season and to reduce cropping as much as is practical in the following year.

A third question centers on mineral nutrition. Nitrogen and boron are key elements for root growth, and soil-applied fertilizer is considered to be more beneficial for stimulating roots than foliar applied fertilizer. The possible loss of winter hardiness from late applications of N to the soil needs to be weighed against the potential tree loss, poor growth and loss of productivity that would result from slow root development following storm damage. However, there is no research-based information to support this judgment. At this time, it is recommended that a maintenance dose of nitrogen and boron be soil applied in early spring following storm damage.

It is very discouraging to see a once beautiful orchard suffer damage in a windstorm, but don't give up. Propping storm-tipped trees is inexpensive in terms of material and labor. Experience has shown that if the damage has occurred in an orchard with desirable varieties, rootstocks, and other characteristics, you will not be throwing good money after bad to salvage the damaged trees.

Severe Hurricane damage caused by soaking rain followed by high winds.

Jim Schupp is an Assistant Professor of Horticulture in the Horticultural Sciences Department at the New York State Agricultural Experiment Station, and is located at the Hudson Valley Laboratory, in Highland, NY. He specializes in growth regulator management and cold hardiness.

Fruit Russet in the Empire State: An Industry Perspective

M.C. Heidenreich[1], T.J. Burr[1], D. Breth[2], S. Hoying[2], K. Iungerman[3], C. Torrice[4], M. Fargione[5]

[1]Dept. of Plant Pathology, NYS Agricultural Experiment Station, Cornell University, Geneva, NY 14456.

[2] Lake Ontario Fruit Team, Cornell Cooperative Extension, Albion and Newark, NY

[3] Northern NY Fruit Program, Cornell Cooperative Extension, Saratoga, NY

[4] Oswego County Cooperative Extension, Mexico, NY

[5] Hudson Valley Fruit Program, Ulster County Cooperative Extension, Highland NY

Fruit russet is a growing concern for the New York apple industry, resulting in increased use of preventive measures to keep russet caused losses in profits at a minimum. Recent research has demonstrated that two common apple fungal epiphytes, *Aureobasidium pullulans* and *Rhodotorula glutinis*, are probably important causes of fruit russet in New York orchards.

This work supported in part by the New York Apple Research and Development Program and the New York State IPM Program.

Recently, a survey of New York growers, packer/processors and consultants was conducted to better define industry problems with fruit russet of apple. The survey developed by researchers at the New York State Agricultural Experiment Station Department of Plant Pathology and regional Cornell Cooperative Extension personnel was distributed to individuals working with apples throughout the Empire State. The purpose of the survey was four-fold: 1) to determine which cultivars currently under production are most susceptible to russet, 2) to discover what preventive measures are being recommended by consultants or used by growers to reduce russet, 3) to determine whether a correlation may exist between site characteristics and russet incidence, and 4) to examine the economic impact of fruit russet on fruit marketability and grower profits. Over 100 people responded to the three surveys, each of which was tailored specifically for the group responding to it. Survey results confirm that fruit russet is a growing concern for the New York apple industry, resulting in increased use of preventive measures to keep profit losses due to russet at a minimum.

Fruit Russet: The Growers' Perspective

While all growers agreed that russet was neither their only concern in apple production, nor perhaps their most important concern, 82 percent indicated they had russet problems with at least one of the cultivars they were producing. Fifty-four cultivars were reported as developing either whole-fruit russet, stem-end russet, or both. Those falling in the russet "Top 10" are listed below in Tables 1 and 2. When asked which cultivar, in their opinion, was their worst russet problem, growers replied that Golden Delicious is still the best of the "worst," followed by Crispin and Cortland.

Forty-seven percent of New York apple growers are now using some sort of russet control strategies. What are they doing to reduce russet in their orchards? Control measures varied widely, and included 32 different cultural, chemical, and application strategies. Those most widely used include: avoiding pesticide applications during slow-drying conditions, applying Provide 2% or opting to use Captan as part of their normal scab control programs.

TABLE 1

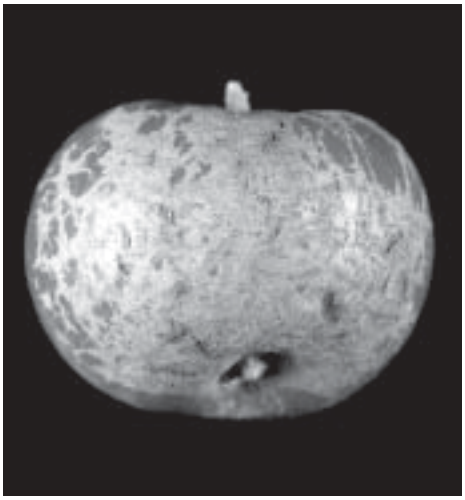
Whole fruit russet

Cultivar	Ratio of respondents reporting russet/total respondents	Percentage of repondents reporting russet
Cortland	26/47	55
Ida Red	18/32	56
Crispin	29/49	59
Jonagold	16/26	62
McIntosh	38/61	62
Empire	29/45	64
Gala	14/21	67
Rome	16/24	67
Fuji	11/15	73
Golden Del.	45/56	80

TABLE 2

Stem end russet

Cultivar	Ratio of respondents reporting russet/total respondents	Percentage of respondents reporting russet
Cortland	26/47	55
Rome	16/29	55
McIntosh	37/64	58
Empire	29/50	58
Gala	14/22	64
Fuji	11/17	65
Ida Red	18/27	67
Jonagold	16/24	67
Crispin	29/39	74
Golden Del.	45/61	74



Russet on McIntosh fruit that was inoculated with *Aurcobasidium pullulans.*

Thirteen site characteristics were reported as possibly being related to russet incidence in New York orchards. The most frequently listed characteristics were slow-drying sites (lower land), and frost pockets. Golden Delicious, Crispin, and McIntosh figured highly among cultivars most affected by russet depending on planting site.

Comments from growers were mixed depending on whether or not they had russet problems in their orchards. For some, russet is an increasing problem; for others, as one grower commented, "Russet is not a concern for my operation, as our fruit is grown for processing." Most growers agreed that russet varied from year to year, with 1999 being a mild russet year compared to the 1997 and 1998 growing seasons. Growers theorized russet development was due in part to weather conditions during the first half of the growing season. They felt that cold, wet conditions and frost often led to russet problems later in the season. Some were of the opinion that open pruned trees with good light penetration and the capacity for rapid drying developed less fruit russet.

The Consultants' Perspective

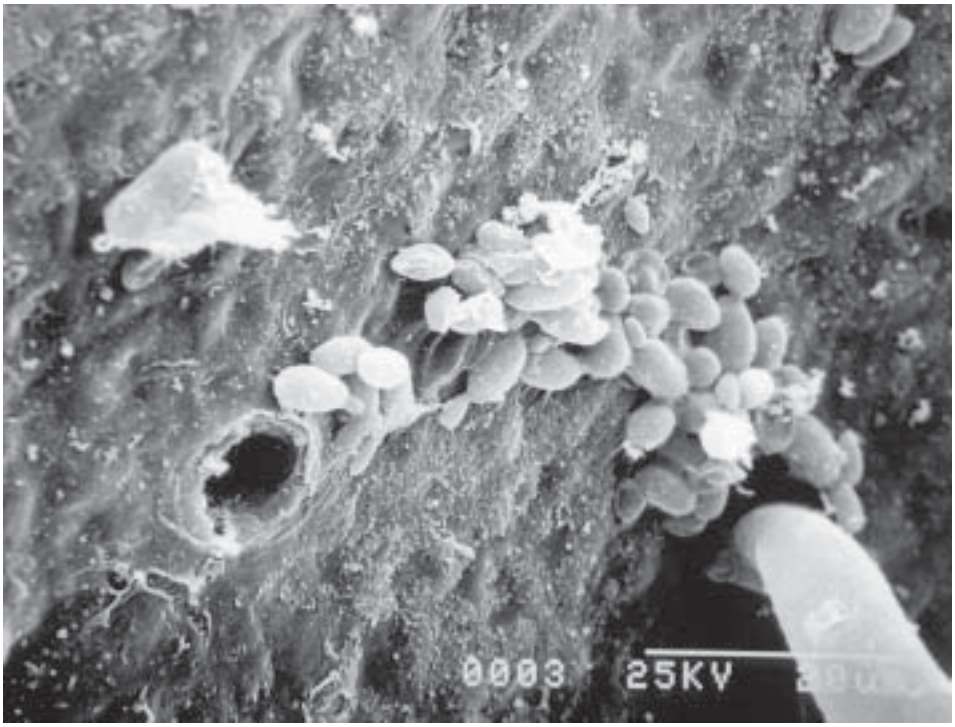
It was unanimous; all the responding consultants reported problems with fruit russet being brought to their attention by growers. Sixteen cultivars were cited as having russet problems; those listed most often fall on the grower "Top 10" list above. Golden Delicious was the worst cultivar overall for russet problems. It was clear from the responses received that growers are taking their advice in terms of russet control strategies as their top three answers on this topic were the same in both cases. Below is a synopsis of the consultants' advice:

1. Carefully select application times: avoid slow drying conditions, such as late evening; don't spray when tem peratures are over 80 degrees.
2. Use Provide 2% on high-value "problem cultivars."
3. Consider the use of Captan as part of your early season scab program.
4. Avoid copper applications after 1/2" green, and oil under cool, wet condi tions.
5. Always check spray mix compatibili ties.
6. Avoid using emulsifiable concentrates on sensitive cultivars.

One consultant commented that russet was becoming more of a problem for several reasons: fungicides are now being applied more selectively and less frequently on a calendar type schedule; fewer fungicides are available for season-long use; and development of fungicide resistance is occurring in some orchards.

The Packers/Processors' Perspective

Responses were mixed between packers and processors. According to reports received, processing apples are rarely



Electron micrograph of *A. pullulans* spores on the surface of an inoculated McIntosh fruit. Erosion of the fruit surface was apparent within seven days.

TABLE 3

Annual losses due to fruit downgrading as a result of fruit russet.

Cultivar	# bins downgraded	Loss\bin ($)
Cortland	500	20
Crispin	1000	10-50
Empire	300	20
Fortune	——	10-50
Fuji	6	83
Gingergold	100	20
Golden Del.	585	20-80
Jonamac	30	100
McIntosh	——	10-50
Marshall Mac	200	20
Red Del.	400	20
Red Del. Earlibrite	——	10-50

TABLE 4

Annual losses due to fruit rejection as a result of russet

Cultivar	# bins rejected	Loss/bin ($)
Crispin	100-1,500	10-70
Fuji	——	10-50
Fortune	——	10-50
Golden Del.	100-450	30-100
McIntosh	——	10-50
Marshall Mac	1,000	100
Red Del. Earlibrite	——	10-50
Rome, Law	500	100

downgraded or rejected due to fruit russet. The response from packing houses was quite the opposite, in fact. Eighteen cultivars were reported as having russet problems; with Golden Delicious and McIntosh being the worst cultivars overall. Tables 3 and 4 show potential losses to growers during severe russet years. Packer comments were in the same vein as growers; russet is a continuing problem and overall the incidence seems to be growing. They felt russet was a concern not only in dollar losses to growers due to downgrades or rejection, but also in sales losses at retail. One commented, "If the fruit doesn't look attractive, people don't buy it. A severe russet year can make the industry as a whole look bad—like we aren't doing our job properly."

Where Does Industry Go From Here?

Fruit russet is not a new problem for apple growers. Previous research has shown that russet is a physiological response on the part of the fruit to penetration of its outer defense, the wax and cuticle layer. When this defense is breached, a wound response is initiated in an attempt to wall off the invasion. This may happen in response to cell damage from various sources such as insect feeding, frost injury, phytotoxicity caused by certain pesticides and others. Recent research has demonstrated that two common apple fungal epiphytes, *Aureobasidium pullulans* and *Rhodotorula glutinis*, are probably important causes of fruit russet in New York orchards.

Fruit russet research efforts are being coordinated by Dr. Tom Burr and Cathy Heidenreich, from the Department of Plant Pathology, New York State Agricultural Experiment Station, Geneva, New York. Both basic and applied research are currently underway. Dr. Martin Goffinet, from the Department of Horticultural Sciences, along with his assistant Mary Jean Welser, are looking at the infection process of these fungi to determine how they initiate russet with both light and electron microscopy. Plant pathologists Dr. Wolfram Koeller and Diana Parker are also involved in the multi-disciplinary research project. They are spearheading efforts to look at the ability of the fungi to digest wax and cuticle. Along with the orchard research efforts of Burr and Heidenreich at the Experiment Station, Debbie Breth and Steve Hoying are coordinating efforts with growers to look at russet management and environmental conditions that may trigger infection periods in the orchard.

The New York State Apple Research and Development Program, a grower supported organization, and the New York State Integrated Pest Management Program have helped to fund research efforts on fruit russet in the state. Both groups provided funding for the russet survey.

Cathy Heidenreich is a research technician who works with Dr. Tom Burr. He leads Cornell's research efforts in bacteriological diseases of fruit crops in the Plant Pathology Department at Geneva. Debby Breth is a Regional Extension Educator with the Lake Ontario Regional Fruit Team, and located in Albion. She specializes in integrated pest management. Steve Hoying is a Regional Extension Educator with the Lake Ontario Regional Fruit Team, and located in Newark. He specializes in horticultural management. Kevin Iungerman is a Regional Extension Educator with the Northern NY Regional Fruit Program, located in Balston Spa. He specializes in fruit crop management. Caleb Torrice is a county extension educator who conducts a two-county fruit program in Oswego and Onondaga Counties and is located in Mexico, NY. Mike Fargione is a county extension educator who conducts a five-county regional fruit program in the Hudson Valley. He is located at the Hudson Valley Lab in Highland.

Getting Started with Grapes

Timothy E. Martinson

Finger Lakes Grape Program, Cornell Cooperative Extension, Penn Yan, NY 14527

Grapes would appear to be an ideal alternate crop for tree fruit growers. If you are considering growing grapes, this article is a must read. It will help you understand that it is important to consider markets, site selection, costs and potential returns.

Grapes would appear to be an ideal alternate crop for apple growers. With the exception of mechanical harvesters, apple growers have much of the equipment necessary to grow grapes. Apple growers also have experience with the year-to-year variability inherent in managing a perennial crop along with a labor force to accomplish manual tasks such as pruning, tying, and in some cases harvest.

If you are considering growing grapes, it is important to consider markets, site selection, costs and potential returns. These areas will be addressed in this article.

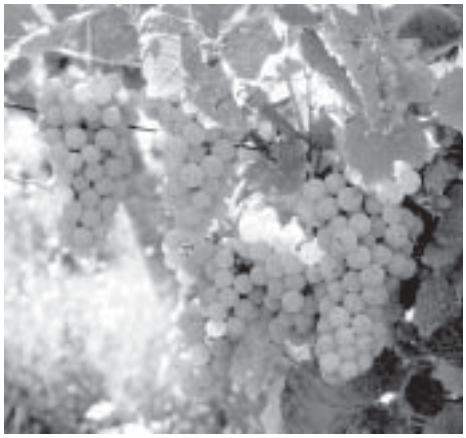
Varieties and Markets

The first question you need answered is what kinds of grapes am I interested in growing and to whom am I going to sell them?

Cultivars. There are over 30 varieties of grapes grown in New York. These are divided into 3 categories. Native varieties such as Concord, Niagara, Elvira, Catawba and Delaware have traditionally been the mainstay of the industry, and are mostly hybrids of *Vitis labruscana*. They are also known as labrusca-type grapes. Interspecific hybrids, or French hybrids, are wine and table grape varieties developed through crosses of various American grape species or varieties and *Vitis vinifera*. This group also includes varieties such as Cayuga White, Traminette, and Marquis as well as table grape varieties produced through Geneva's grape breeding program. The third class is *V. vinifera* varieties, also known as *vinifera* grapes. These are the classic premium wine grapes, such as Riesling, Chardonnay, Pinot Noir, Cabernet Franc, Cabernet Sauvignon, and Gewurztraminer.

Training and pruning systems, disease susceptibility, winter hardiness, and price per ton vary widely among the different categories. Native grapes, which comprise 70 percent of the acreage in the Finger Lakes, have the highest yield potential (6-8 tons/acre, well managed on good sites), and the lowest prices per ton (Table 1). *V. vinifera* (8 percent of Finger Lakes acreage), or premium wine grapes, bring the highest price per ton, and typically produce yields of 2.5 to 4.5 tons/acre. Hybrid grapes (22 percent of acreage) fall in the middle, with some varieties near the 'native' end of the spectrum and some toward the premium end. Prices for hybrids (particularly reds) have rebounded from the $200-300 per ton over the past several years, increasing to $400-$600 per ton as the small winery segment has grown.

Markets. There is a wide variety of markets for grapes. Native cultivars are sold mostly to large processors for bulk wine or grape juice. For these markets, high tonnage, along with adequate brix (maturity) are key factors, along with low production costs. With production costs of roughly $1200 per acre, average yields in the 7-8 tons/acre range are considered to be necessary for long-term profitability. Most of the *vinifera* grapes are grown by or sold to small and medium-size wineries, both in and outside of New York State. They require more intensive management, with production costs running in the $2000 to $3000 per acre range. Quality is increasingly important, and buyers are specifying the use of specific training systems, fungicides, and quality levels (e.g. lack of bunch rot). At current prices of $1100 to $1700 per ton, the break-even yield in the Finger Lakes is around 3 tons/acre. This is easily obtainable at the best sites, but may be difficult in less than optimum locations. The wide variety of hybrids again fall somewhere in the middle. They are purchased by both bulk wine producers and small wineries, as well as by brokers who crush the grapes and sell the juice to wineries throughout the northeast. Four to six tons is reasonable for many varieties in this group. Finally, table grape production may be an attractive option for some. Fifteen seed-



Cayuga White, developed at Geneva, is a productive, easy to grow hybrid that is produced both as a varietal wine and used in blending for proprietary wines.

TABLE 1

Prices ($) per ton offered by processors for different categories of grapes in 1999.

Type	Average	High	Low
Native grapes	289	353	216
Red Hybrids	528	613	457
White hybrids	441	500	394
Red vinifera	1,460	1,557	1,300
White vinifera	1,327	1,459	1,143

less and ten seeded varieties suitable for table grape production are listed in two Cornell bulletins (Reisch et al., 1993a, 1993b). Most are grown in small acreage plantings for sale at farm markets and local supermarkets.

Site Selection. The second and more important question is "What kinds of grapes can I grow and where?"

Site suitability varies dramatically across the state, and the various varieties have different requirements. It is important to recognize that the climate of New York is the most important determinant of site suitability. What distinguishes New York from most other grape producing regions is that winter temperatures are lower here. If we compare NY with Dijon, France, in the heart of Burgundy (Figure 1), the main climatic difference is that average winter temperatures—even on Long Island—are considerably lower than those of Dijon.

Because of our cold winter climate, local temperature variations are very important for site selection. Differences of a few degrees in winter low temperatures can be the difference between winter injury occurring in one of three years or one in ten years. The second consequence is that cultural practices for cold-tender varieties are geared toward preventing and recovering from winter injury. Hilling up soil to protect the graft union, continual trunk renewal, delayed pruning, and adjusting bud numbers to compensate for winter injury are all routine practices in most New York vineyards.

Important factors to consider when choosing a site include mesoclimate and soil characteristics (Table 2).

Climate requirements include moderate winter low temperatures that minimize winter injury to trunks and buds (rough guide shown in Table 3), low probability of late spring or early fall frosts, sufficient growing degree-days to ripen the crop, and adequate air drainage, to lessen the danger of frost injury and to minimize disease severity. Of these characteristics, the only one easily modified is air drainage. On specific sites, air drainage can be improved by removing trees and hedgerows that block air flow or by leveling out small dips and depressions by moving earth.

Maximum and Minimum

Soil requirements include adequate rooting depth, good internal soil drainage, good water-holding capacity, appropriate soil pH, and adequate nutrient status. Most of these characteristics can be modified to improve the site. Tiling will improve internal drainage, soil pH can be modified with lime, and irrigation can compensate somewhat for poor water-holding capacity. Shallow soils (<30" depth), soils with root-restricting layers, or water-limited soils are hard to improve, and will limit vine size and yield potential. The best vineyard soils are deep to moderately deep well-drained gravelly loams.

The good news for apple growers along Lake Ontario is that the lake provides good climate moderation, and helps reduce the risk of winter injury. The bad news is that there tends to be fewer heat units along the lake, which may limit your choices to early- or mid-season varieties, or increase the need to crop thin to hasten ripening.

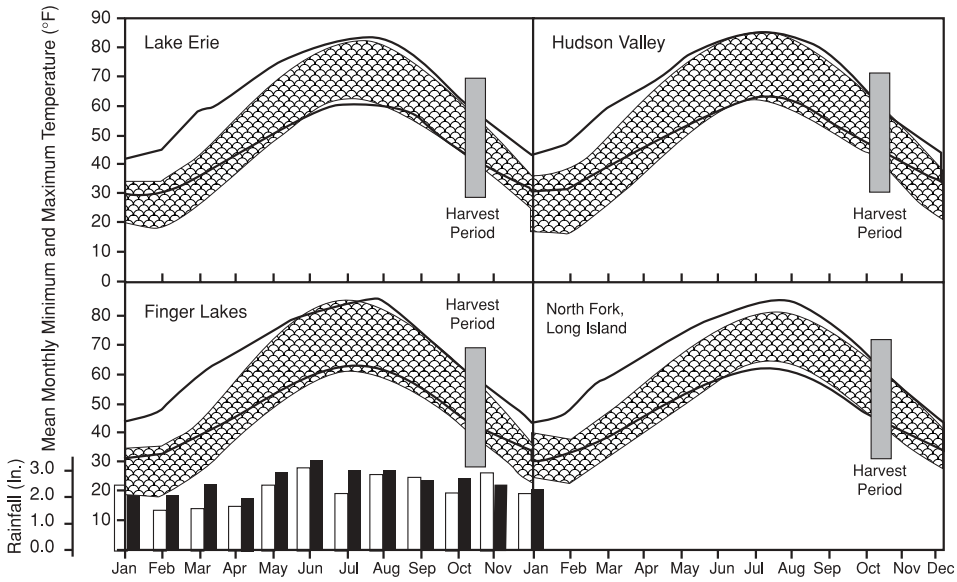


Figure 1. Average monthly minimum and maximum temperatures in Dijon, France, in comparison with four NY grape-growing regions. Solid lines indicate temperature range in Dijon. Hatched lines indicate temperature range in the indicated New York region. Average monthly precipitation of Dijon and Geneva, NY are shown in lower left corner. Source: http://www.nysaes.cornell.edu/hort/faculty/pool/NySite-Soils/terroir.html. Courtesy Bob Pool.

Cost of Vineyard Establishment

Two recent bulletins (White, et al. 1997a, 1997b) detail the cost of establishment and growing costs for both generic (Native and ungrafted hybrid) and *vinifera* grapes. The two bulletins, however, do not provide directly comparable figures. Table 4 provides a summary of the most important differences in establishing Native vs. *vinifera* grapes. These are:

- Trellis costs are greater for *vinifera* grapes, because *vinifera* training systems use more wires.
- Vines cost are greater for *vinifera* grapes, because *vinifera* are grafted and planted at higher number of vines per acre.
- Hilling up vines during establishment is necessary only with cold-sensitive varieties.
- More intensive disease management (8 sprays vs. 3-5) is necessary with *vinifera* grapes.

TABLE 2

Climate and soil characteristics important in site selection

Climate	Soils
- Winter low temperatures	- Rooting Depth
- Probability of spring/fall frost (Days between 28° temperatures)	- Water holding capacity
- Sufficient heat units (growing degree-days)	- Internal drainage
- Topography (air drainage)	- Soil pH/nutrient status

I have tried to summarize in this brief article some basic factors to consider when thinking about planting grapes. A suitable site is the most important factor in establishing a vineyard. There are great opportunities for those looking to expand farm markets by offering fresh table grapes grown in New York. There are also opportunities to establish wineries in areas along the lake already frequented by tourists, or to partner with existing wineries that are looking to expand their markets. In the juice grape market, demand is strong for Niagara grapes, and some processors are looking for additional tonnage for future expansion. This may be an opportunity for those who can secure commitments from processors and have access to mechanical harvesters.

Dr. Timothy E. Martinson is a viticulture extension educator who leads the multicounty Finger Lakes Grape Program based in Penn Yan, NY. His e-mail address is: tem2@cornell.edu

Growing grapes near large bodies of water and on moderate to high slopes reduces the chance of damaging winter low temperatures and provides air drainage to reduce the risk of spring and fall frosts.

References

Reisch, B., R. M. Pool, D. Peterson, M. Martens, and T. Henick-Kling. 1993b. Wine and juice grape varieties for cool climates, Bull. 233, Cornell Cooperative Extension, Geneva, NY.

Reisch, B, R. D. Peterson, M. Pool, and M. Martens. 1993a. Table grape varieties for cool climates, Bull. 234, Cornell Cooperative Extension, Geneva, NY.

White, G. B., B. Shaffer, R. M. Pool, & A. Lalor. 1997a. The economics of replanting generic wine grape varieties in New York. Dept. ARME Publication # RB 97-05. April 1997, Cornell University, Ithaca, NY.

White, G. B., D. V. Peterson, & T. E. Martinson. 1997b. Cost of establishment and production of *vinifera* grapes in the Finger Lakes region of New York. Dept. ARME Publication # EB 99-04. Cornell University, Ithaca, NY.

TABLE 3

Mid-winter low temperatures and hazard to grapevines.

If low temperature is higher than:	Injury hazard is:	Suitable Varieties
0°F	Very low	Almost any
-5°F	Low	Most northern vinifera
-10°F	Moderate	Hardy vinifera/ moderately hardy hybrids
-15°F	High	Hardy hybrids/most Native varieties
< -15°F	Very high	Hardy Native varieties

TABLE 4

Costs for establishing Native/Generic varieties vs. V. vinifera varieties.

Cost	Native/ Generic	Vinifera
Trellis construction	$1,200	$1,748
Vines	$600	$2,400
	(ungrafted, 9x8' spacing)	(grafted, 8 x 6' spacing)
Other 1st year costs	$1,800	$2,400
Total establishment cash costs (Yr. 1 to 3)	$4,600	$7,046
Annual growing costs (cash only)	$605	$1,470
Annual costs (including amortization, fixed costs)	$1,658	$3,542

Order your copy today!

The 100-year history of the state's premiere horticultural research center.

The First 100 Years of the

New York State Agricultural Experiment Station

at Geneva, NY

1882-1982

Written by P. J. Chapman(right) and E.H. Glass (left)

An in-depth story of the people and advances at the Station that have helped propel food and agriculture into a multi-billion dollar segment of the New York economy.

Featurng 96 historical photos from the Station's archives in a handsome 309-page book. Available in hard- or soft-cover.

SOFTCOVER: $28.85
(includes shipping and handling)

HARDCOVER: $35.05
(includes shipping and handling)

Please send your order, and check, payable to Cornell University to:

Cornell University
Resource Center,
7 Cornell Business &
Technology Park,
Ithaca, NY 14850

E-mail: resctr@Cornell.edu

MasterCard and Visa by mail or phone (607) 255-2080.

- Prices include handling and mailing within the continental United States.
- Orders sent outside the U.S. must be prepaid in U. S. funds drawn on a U. S. bank.
- NYS residents must add 8% sales tax to your total order.

Please ship me my copy of
The First 100 Years of the New York State Agricultural Experiment Station at Geneva, NY

Ship to:

Name_____

Street Address (for UPS)_____

City_____ State _____ Zip Code_____

Soft cover .....Price.....$28.85	
# copies	x_____
SUBTOTAL	$_____
Hard cover.....Price.....$35.05	
# copies	x_____
SUBTOTAL	$_____
NYS Tax (8%)	$_____
TOTAL	$_____