NYFVI PROJECT

REMOVING BARRIERS TO INCREASE HIGH TUNNEL PRODUCTION OF HORTICULTURAL COMMODITIES IN NEW YORK

ECONOMIC AND MARKETING STUDY FINAL REPORT

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This economic and marketing study is part of the New York Farm Viability Institute funded project titled "Removing Barriers to Increase High Tunnel Production of Horticultural Commodities in New York". Crops included in this study are two vegetable crops (tomato and English cucumber), two cut flower varieties (lisianthus and sunflower), and one fruit crop (fall raspberry).

The costs of production budgets presented in this report are based on New York growing and production conditions in 2006 and 2007. Market prices of studied crops were collected from various marketing channels and outlets in 2006 and 2007 and analyzed to review pricing windows and market opportunities.

PART I. ECONOMIC STUDY

The costs of production budgets are developed as case studies of each crop as produced on collaborative farms. It should be noted that timing and types of cultural practices vary among individual growers within the region and from season to season due to variability in weather, soil, insect and disease pressure, and management style.

Production budgets in this study are based on the 2006 and 2007 conditions and figures. Production costs are presented by input and by operation in the report. Fixed costs in each enterprise budget only include the annual costs for construction of the high tunnel. The economic data were collected by extension educators in collaboration with farmers who grew the selected crops and compiled into budget format by the authors.

The purpose of the sample budgets is to help growers estimate and calculate costs and receipts for their own farms. Cost items are numerous and vary among individual farms and production practices. Growers should treat these sample budgets as an approximation and make appropriate adjustments to reflect their specific production and resource situation.

The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the authors and Cornell University, nor is any criticism implied by omission or other products or cultural practices.

Economics of High Tunnel Tomato and English Cucumber Production

Growing vegetables in high tunnels gives growers the opportunity to extend their marketing season both early and late in Upstate New York and, therefore, increase their ability to compete with products imported from other states or regions. Under the high tunnel system, vegetables are planted directly in the ground. Plastic tunnels protect the plants from rain and other weather conditions and capture the sun's natural heat and light. Unlike greenhouses, the high tunnel production system typically does not use artificial light or heat. Temperature and ventilation control is vital for the production of a healthy and abundant vegetable crop. The key of high tunnel vegetable production is to maintain low humidity in conjunction with high soil moisture. Temperature levels are maintained between 60 and 80 degrees Fahrenheit.

Production of early tomatoes is the quest of most vegetable farmers in the Northeast. Although using greenhouses or high tunnels with heating systems is generally considered the best way to produce early tomato crops, another option is to use unheated high tunnels to gain up to a month earlier crop over field production. In this report, we provide two high tunnel tomato production case studies (heated and unheated high tunnels), and one high tunnel English cucumber production case study (unheated high tunnels).

The two case study farms (Farm A and Farm B) had very different production practices. Farm A produces tomatoes and English cucumbers using a typical unheated high tunnel in Yates County, New York. Farm B's tunnel located in Tioga County, New York and is equipped with heat and electrical hookups that allow the grower to set out tomato plants as early as February or March. The high tunnels used by both farms are classified as temporary agricultural structures because no concrete footings were used to anchor the foundation posts. Energy, labor and material costs, along with information about the growing and harvesting periods are presented to allow comparison between the basic, unheated tunnel operation (Farm A) and the heated high tunnel operation (Farm B). Since the production costs are similar for 2006 and 2007 for tomatoes, 2006 production costs are used in the budget, and information on yield and revenue for both 2006 and 2007 is presented when available.

Collaborating extension educators were Judson Reid, Cornell Cooperative Extension, Yates County (Farm A) and Molly Shaw, Cornell Cooperative Extension, Tioga County (Farm B).

- **Farm A – Growing Tomatoes and English Cucumbers in Unheated High Tunnels**

First, we will discuss enterprise budgets for producing tomatoes and English cucumbers in *unheated* high tunnels by Farm A. On Farm A, tomatoes were produced in a 20 X 240 feet tunnel (4,800 square feet), while English cucumber was grown in a 20 X 120 feet tunnel (2,400 square feet). The tunnels are fitted with battery-operated rollup sides that can be connected to a temperature gauge to rise automatically on the hottest days.

The tunnel cost estimates are based on the actual prices paid by the farmer for materials, and a monetary value is assigned to the amount of labor required to build the high tunnels even when unpaid family labor was used to assist in building the high tunnels and other production

operations. The tunnel materials and irrigation equipment are assumed to be amortized over 10 years and the plastic covering over three years. The system used in the tunnels to produce tomatoes and English cucumbers includes black plastic mulch, drip irrigation, and a trellis or support structure.

A total of 900 *"Geronimo"* tomato transplants were purchased for $1 each, and 400 English cucumber transplants in 4'' pots were purchased for $0.50 each in 2006. Production costs for the growing period include supplies and labor for fertilization, disease and pest management, staking and training plants, pruning, weeding, and monitoring and ventilation. Mulch and drip irrigation systems keep the foliage dry to reduce mold growth on the plants. The farm also attains higher production by trellising and high plant density. Also, a low-pesticide approach is used for pest management, and buyers are reassured to learn the farm employing low-pesticide practices.

Farm A's high tunnel tomato production yielded 14,400 pounds in 2006 and 17,300 pounds in 2007 (15 to 20 pounds of saleable tomatoes per plant). While Farm A planted 400 English Cucumber plants in 2006, it planted 1,200 plants in 2007 in the same space. As a result, English cucumber production yielded 3,000 pounds in 2006 and 12,360 pounds in 2007. The farm sold produce through wholesale (primary buyers or first handlers), local farmers markets, and the Finger Lakes Produce Auction starting in early July.

- **Farm B – Growing Tomatoes in Heated High Tunnels**

Farm B produced tomatoes in a heated 30 X 96 feet high tunnel (2,880 square feet) with five beds in 2006. A standby heater was used as needed to prevent frost damage early or late in the growing season. A single layer (6 mils) of polyethylene greenhouse film was used to cover the tunnels. Plastic mulch and irrigation drip tape (underneath the mulch) were installed. A total of 400 grafted tomato seedlings purchased for $2.3 each were transplanted into the tunnels in mid-March 2006. Pollination is a large problem with early plantings, therefore, a leaf blower was used to move the plants and get pollination. Later plantings that use natural ventilation (roll-up sides) generally pollinate from the wind and other insects. When necessary, a liquid fertilizer solution was injected into the irrigation water. As the plants grew, strings and clips were used to keep the plants growing in an upright direction and to support the weight of the tomatoes. The tomatoes were scouted to check for insect infestations, and pesticide was applied only when necessary. This farm sold all of its produce in a local farmers' market from mid-June to October. It was estimated that tomatoes made up 6 percent of farm income, therefore, 6 percent of the general marketing costs was allocated to the tomato crop in the budget.

Estimated Production Costs for Tomatoes in an Unheated High Tunnel (Farm A) 2006 and 2007

Operation	Input	Unit	Quantity	Price	$/Tunnel
High Tunnel Preparation					
Black Plastic Mulch	Material	linear foot	960	0.02	19.2
	Labor	hr	16	10.00	160.0
Irrigation System	Drip Lines	linear foot	1,920	0.02	38.4
	Labor	hr	2	10.00	20.0
Total					**237.6**
Production					
Transplanting	tomato plants	each	900	1.00	900.0
	labor	hr	32	10.00	320.0
Fertilization and Irrigation	fertilizer	bag	20	5.00	100.0
	labor	hr	42	10.00	420.0
Staking and Training	Twine, clips	per plant	0.5	900.00	450.0
	labor	hr	192	10.00	1,920.0
Pruning	labor	hr	192	10.00	1,920.0
Weeding	labor	hr	72	10.00	720.0
Pest Control (predatory mites)	Pesticides	1,000	3	33.00	99.0
	labor	hr	0.25	10.00	2.5
Ventilation and monitoring	labor	hr	42	10.00	420.0
Total					**7272.0**
Harvesting					
Picking, packing	25# boxes	each	576	0.5	288.0
	labor	hr	26.4	10.0	264.0
End of season clean up	labor	hr	12	10.0	120.0
Total					**672.0**

Fixed Costs	Price ($)	Projected Life (yrs)	Annual Cost ($)
Frame Package	5,500	10	550
Hardware	1,,000	10	100
Irrigation/Fertigation System	200	10	20
Tunnel Construction Labor	480	10	48
Plastic Coverings	480	3	160
Covering Replacement labor	360	3	120
Total			**1,558**

Growing season:	2006	2007
Type of High Tunnel:	Welded-quansit	Welded-quansit
Tunnel Size (sq. ft.):	4,800 (20x240')	4,800 (20x240')
Number of Plants:	900	900
Variety or Cultivar:	Geronimo	Geronimo
Marketing Channel:	Wholesale, auction and retail farm market	
JUYield:	16.0 lbs/plant =14,400 lbs	21 lbs/plant =18900 lbs
Total Revenue	10800	14175
Total Costs	**$ 9,739.6**	**$ 9,739.6**
Net Income	1060.4	4435.4

Estimated Production Costs for English Cucumbers in an Unheated High Tunnel (Farm A), 2006

Operation	Input	Unit	Quantity	Price	$/Tunnel
High Tunnel Preparation					
Soil Test	test	Time	1	15	15.0
Land Preparation	Compost	Ton	1.5	35	53.0
(Tillage, Rototill, Raised Bed…)	Machinery	Total	1	15	15.0
	Labor	Hr	6	15	90.0
Black Plastic Mulch	Material	linear foot	480	0.02	9.6
	Labor	Hr	12	10	120.0
Irrigation System	Drip Lines	linear foot	480	0.02	9.6
	Labor	Hr	2	10	20.0
Total					**331.7**
Production					
Cucumber Transplants	Plants	4" pots	400	0.5	200.0
	Labor	Hr	24	10	240.0
Fertilization	Material	pounds	22.5	1	22.5
	Labor	Hr	3	10	30.0
Pest Control Chemicals	Beneficials	1000 mixed	8	33	264.0
	Pesticide	Mixed	1	5	5.0
	Labor	Hr	4	15	60.0
Staking and Training the Plants	Twine and clips	Unit	400	0.5	200.0
	Labor	Hrs	10	10	100.0
Pruning	Labor	Hrs	20	10	200.0
Weeding	Labor	Hrs	18	10	180.0
Seasonal Clean-up	labor	Hrs	6	10	60.0
Total					**1561.5**
Harvest					
Picking, Grading and Packing	Boxes	cartons	167	0.5	83.5
	Labor	Hrs	144	10	1440.0
Total					**1523.5**

Fixed Costs	Price ($)	Projected Life (yrs)	Annual Cost
Tunnel Materials	2750	10	275
Irrigation/ Fertigation System	200	10	20
Tunnel Construction Labor	360	10	36
Plastic Coverings	250	3	83
Covering Replacement labor	120	3	40
Total			**694**

Growing season:	**2006**
Type of High Tunnel:	Welded-quansit
Tunnel Size (square feet):	2400 (20x120')
Number of Plants:	400
Variety or Cultivar:	10 varieties
Yield:	4,000 lbs
Marketing Channel:	On-farm wholesale, wholesale auction and retail farm market
Total Revenue	**1666.66**
Total Costs	**$ 4,110.7**
Net Income	**(-2444.03))**

Estimated Production Costs for English Cucumbers in an Unheated High Tunnel (Farm A), 2007

Operation	Input	Unit	Quantity	Price	$/Tunnel
High Tunnel Preparation					
Soil Test	test	time	1	15	15
Land Preparation	Compost	ton	1.5	35	53
(Tillage, Rototill, Raised Bed…)	Machinery	Total	1	15	15
	Labor	hr	6	15	90
Black Plastic Mulch	Material	linear foot	480	0.02	9.6
	Labor	hr	12	10	120
Irrigation System	Drip Lines	linear foot	480	0.02	9.6
	Labor	hr	2	10	20
Total					**331.7**
Production					
Cucumber Transplants	Plants	4" pots	1200	0.5	600
	Labor	hr	72	10	720
Fertilization	Material	pounds	67.5	1	67.5
	Labor	hr	3	10	30
Pest Control Chemicals	Beneficials	1000 mixed	2	100	200
	Pesticide	Mixed	0	0	0
	Labor	hr	1	10	10
Staking and Training the Plants	Twine and clips	unit	1200	0.5	600
	Labor	hrs	30	10	300
Pruning	Labor	hrs	60	10	600
Weeding	Labor	hrs	54	10	540
Seasonal Clean-up	labor	hrs	6	10	60
Total					**3727.5**
Harvest					
Picking, Grading and Packing	Boxes	cartons	501	0.5	250.5
	Labor	hrs	130	10	1300
Total					**1550.5**

Fixed Costs	Price ($)	Projected Life (yrs)	Annual Cost
Tunnel Materials	2750	10	275
Irrigation/ Fertigation System	200	10	20
Tunnel Construction Labor	360	10	36
Plastic Coverings	250	3	83
Covering Replacement labor	120	3	40
Total			**694**

Growing season:	**2007**
Type of High Tunnel:	Welded-quansit
Tunnel Size (square feet):	2400 (20x120')
Number of Plants:	1200
Variety or Cultivar:	N/A
Yield:	13200 lbs
Marketing Channel:	On-farm wholesale, wholesale auction and retail farm market
Total Revenue	**$ 5500**
Total Costs	**$ 5609.7**
Total Revenue	**(-109.7)**

Estimated Production Costs for Heated High Tunnel Tomato (Farm B) 2006 and 2007

Operation	Input	Unit	Quantity	Price	$/ Tunnel
Bed prep					
Soil test	Test every 3 years	sample	0.33	15	5
Rototiller	machine		1	34	34
	labor	hr	0.75	16.5	12
Compost, bed formation	Compost	yd	3	18	54
	labor	hr	3	16.5	50
Raised bed formation	labor	hr	2	16.5	33
Fertilizer/lime	25 lb bag 4-18-38	bag	2	8	16
Plastic mulch	Material	feet	450	0.02	9
white on black, 4ft wide	labor	hr	2.5	16.5	41
Drip tape fittings	fitting		15	2	30
drip tape w/ 1' emitters	tape	feet	1,350	0.0175	24
	Staples	box	1	12	12
	labor	hr	0.75	16.5	12
Total					**332**
Production					
Transplanting	tomato plants	each	400	2.3	920
	labor	hr	2.5	16.5	41
Fertilization and Irrigation	starter fertilizer	lb	5	1.4	7
	labor	hr	0.8	16.5	13
Staking	Twine	roll	1	17	17
	Clips	1000	4	11.5	46
	labor	hr	2.5	10.5	26
	labor	hr	5	16.5	83
Pruning/Training	labor	hr	23	10.5	242
	labor	hr	20	16.5	330
Pest Control (Pesticides)	Admire	oz	3.5	8.19	29
	Bravo	qt	1	5.59	6
	Quadris	oz	4	2.8	11
	T-22	lb	0.5	93	47
	Sprayer	each	25	1	25
	labor	hr	2	16.5	33
Heating (starting March 7)	Gas	11 wks	1	2,000	2,000
Pollinating	labor	hr	20	16.5	330
Venting	labor	hr	12	16.5	198
Total					**4,403**
Harvesting					
Picking, packing	peck baskets	each	50	0.3	15
	labor	hr	30	16.5	495
End of season clean up	labor	hr	1.5	16.5	24.75
	labor	hr	5.5	10.5	58
Total					**593**
Marketing (June 13-Oct 31):					
Market fees	Farmers' Market	Day	120	0.3	36
(6 days/ wk)	Labor	week (66 hr)	20	39.6	792
Total					**1,421**

Estimated Production Costs for Heated High Tunnel Tomato (Farm B), 2006 and 2007 - Continued

Fixed Costs	**Price ($)**	**Projected Life (yrs)**	**Annual Cost**
Tunnel , 5 beds, 96 ft long each	30,000	15	2,000
Hot Air Furnace	1,500	15	100
Construction Labor	1,440	16	90
Hot water heater—w/ 3/4" black pipe, 2 lines/bed, 12" deep	250	10	25
Reglazing, 6 mil, two 33x100ft pieces, two 20x100 ft pieces	920	4	230
Landscape fabric, 3 ft wide, 600 ft	240	5	48
Total			**2,516**

Growing season:	**2006**	**2007 (July 12- Oct 30)**
Tunnel Size (square feet):	96x30	96x30
Number of Plants:	400	400
Variety or Cultivar:	Beefsteak tomato varieties and grape tomato.	Grafted "Buffalo" variety and beefsteak tomato varieties
Yield:	350 pecks of beefsteak tomato, and 110 pints grape tomato	14.25 lbs/ plant beefsteak tomato
Price:	$2,88/lb for beefsteak tomato, $3/pint for grape tomato	$2.88/per pound
Marketing Channel:	Farmers Market	Farmers Market
Total Revenue	**$ 10,410**	**$ 16,416**
Total Costs	**$ 9,265**	**$ 9,265**
Net Income	**$ 1,145**	**$ 7,151**

Economics of Cut Flower Production in Unheated High Tunnels

Cost of production information was collected from an established field-grown cut flower grower in 2006. The farm recently erected a high tunnel (unheated greenhouse) structure covered with a single layer of plastic film. Within the structure were 5 beds, each 4 feet wide. The farm already owned a bed former with plastic film laying capacity. Family skills included construction and field cut flower growing and marketing.

The crops monitored were sunflowers and lisianthus. Sales venues included direct sale to retail florists and at a farmer's market. Two sunflower crops were harvested in 2006. One crop of lisianthus was produced. Poor September weather prevented harvesting a second lisianthus crop.

The structure was amortized over 20 years, lumber and irrigation equipment over ten years, and the plastic cover over three years. The row cover and drip irrigation are replaced annually. Appropriate charges for tractor, construction labor and land use were allocated to the crop.

The crop year began on April 15 and concluded on October 20 in 2006. Plants were grown in a 30 x 96 foot galvanized Gothic arch structure. The grower planted 1,890 lisianthus plugs and 2,400 sunflower seedlings in the structure. Labor charges for planting, fertilization, irrigation, pest management, weeding, staking and pruning were charged as appropriate.

Net revenue for the lisianthus crop was about $6,432 in 2006 and $10, 935 in 2007. Their cost, based on bed space used, was $2.39/square foot. Net revenue per square foot was $3.19 in 2006 and $7.19 in 2007. Total revenue for the sunflower corps was $2,400 in 2006 and $2,534 in 2007. Their cost, based on bed spaced used, was $1.85/square foot. Net revenue per square foot was $0.23 in 2006 and $0.35 in 2007.

The grower believes a second layer of plastic would be a good investment because it would allow better heat retention, particularly in the fall. Supplemental heat in September would assure the second crop of lisianthus to be harvested.

Although lisianthus are a more profitable than sunflowers per unit of space, a medley of product offerings from both the tunnel and fields is seen as superior overall. The information on yield and revenue in 2007 is included. Only 2006 production costs are presented because the production costs in 2007 are pretty much the same as the year before. Collaborating extension educator for the cut flower crops is Walt Nelson.

Estimated Production Costs for High-Tunnel Lisianthus, 2006 and 2007

Operation	Input	Unit	Quantity	Price	$/Tunnel
High Tunnel Preparation					
Black Plastic Mulch	Material	bed	5	$5	25
	Labor	hr	1.5	$14	21
Irrigation System	Drip Lines	bed	5	$7	35
	Labor	hr	4	$14	56
Total					**137**
Production					
Planting	Seeds/ Plants	each	1890	0.27	510
Planting	Labor	hr	7.5	10	75
Transplanting	Labor	hr	7.5	10	75
Fertilization and Irrigation	Fertilizer	mixed	1	40	40
	Labor	hr	4	14	56
Pest Control Chemicals	-	-	-	-	95
Staking Plants	Labor	hr	3	15	45
Pruning	Labor	hr	3.5	10	35
Weeding	Labor	hr	2.5	10	35
Seasonal Clean up	Labor	hr	2	14	28
Total					**994**
Harvest					
Picking	Labor	hr	25	10	250
Grading and Packing	Labor	hr	10	13.5	135
Boxes					
Storage	Electricity	season	1	125	125
Stall fee	farmers market	season	1	60	60
Total					**570**

Structure:	**Price ($)**	**Projected Life (yrs)**	**Annual Cost**
Frame Package	4316	20	216
Construction Labor	4839	20	242
Lumber	509	10	51
Irrigation/Fertigation System	225	10	23
Plastic Coverings	275	3	92
Covering Replacement labor	90	3	30
Total			**1053**

Growing season:	**Apr 15-Oct 20, 2006**	**Apr 15-Oct 20, 2007**
Tunnel Size (square feet):	2880 (30x96'), 5 beds	2880 (30x96'), 5 beds
Number of Plants	1890	1530
Variety or Cultivar	Lisianthus	Lisianthus ABC series
Yield	1340 plants, 6 stems/plant	1041 bunches(5 stems) + 500 bunches(10 stems)
Price	$0.8 per stem	$8 /each bunch
Marketing Channel	Florists 80%, Farmers market 20%	Florists 80%, Farmers market20%
Total Revenue	**$6,432**	**$10, 935**
Total Costs	**$2,754**	**$ 2,657**
Net Income	**$3,678**	**$ 8,278**

Estimated Production Costs for High Tunnel Sunflower, 2006 and 2007

Operation	Input	Unit	Quantity	Price	$/Tunnel
High Tunnel Preparation					
Black Plastic Mulch	Material	bed	5	5	25
	Labor	hr	1.5	14	21
Irrigation System	Drip Lines	bed	5	7	35
	Labor	hr	4	14	56
Total					**137**
Production					
Transplanting	Seeds/ Plants	each	2240	0.2	448
	Labor	hr	4	10	40
Fertilization	Fertilizer	mixed	1	45	45
	Labor	hr	4	15	60
Pest Control	-	-	-	-	60
Weeding	Labor	hr	2.5	10	35
Seasonal Clean up	Labor	hr	3	15	45
Total					**733**
Harvest					
Picking	Labor	hr	15	10	150
Grading and Packing	Labor	hr	6	10	60
Total					**210**

Structure:	**Price ($)**	**Projected Life (yrs)**	**Annual Cost**
Frame Package	4316	20	216
Construction Labor	4839	20	242
Lumber	509	10	51
Irrigation/Fertigation System	225	10	23
Plastic Coverings	275	3	92
Covering Replacement labor	90	3	30
Total			**1053**

Growing season:	**Apr 20- Nov 3, 2006**	**Apr 11- Nov 3, 2007**
Tunnel Size (square feet):	2,880 (30x96'), 5 beds	2,880 (30x96'), 5 beds
Number of Plants	2,400	2,304
Variety or Cultivar	Sunflower	Sunflower
Yield	2,400 stems	2,304 stems
Price	$1 per stem	$1.1 per stem
Marketing Channel	Florists 60%, Farmers market 40%	Florists 75%, Farmers market 25%
Total Revenue	**$2,400**	**$2,534**
Total costs	**$2,133**	**$2,135**
Net Income	**$267**	**$399**

Economics of Growing Fall Raspberries in High Tunnels

High quality, premium raspberries can be produced in a simple, inexpensive high tunnel structure that provides the grower a great deal of season extension and versatility. The grower is able to achieve a high level of quality because high tunnels provide protection from rain and hail, thus reducing the instance of fruit rotting infections, and the fruit can be harvested at the peak of ripeness for optimum favor. Fresh-market raspberries usually are sold in half-pint clamshells. Consumers are willing to pay between $3.00 and $6.00 per half-pint for fresh fruit of superior quality. The actual price received will depend on where a grower's niche market is, how he/she intends to market their fruit, and how he/she advertises and services the market. For example, prices will be lower at pick-your-own in rural locations and higher if sold as ready-picked in locations near population centers.

Because they are highly perishable, raspberries are well suited for roadside stands, farmers' markets, and pick-your-own operations. Raspberry production is appropriate to small farms, as a small area of raspberries can provide significant income. While high prices can be obtained for raspberries, these delicate fruits are susceptible to numerous diseases, require a great deal of labor for hand harvesting fresh-market fruit, and have a very short shelf life. Initial investment in a planting is relatively high, good management skills are needed to produce a quality product, and substantial labor is required.

The key to successful use of the high tunnel is to spend the time laying out and preparing the site for construction. The better the tunnel is constructed, the easier the roll-up sides will work, and the easier it will be to ventilate. Ventilation to avoid high temperatures or high humidity is very important. The floor of the structure is covered with a layer of black weed barrier. This helps to raise the temperature inside the house, control weeds, prevents evaporation of soil moisture and allows excess water to drain. The use of high tunnels does require an increase in both the level and the amount of management required to grow the crop. The sides must be raised and lowered to regulate temperature and humidity. Plants must be irrigated regularly and fertigated as needed. Disease problems may occur in the protected environment; management of the environment is critical. Also, unpredictable weather in spring and fall will make management intensive.

Included in this report are four sequential annual budgets for red raspberry production. The first two summarize the costs of land preparation and establishment of the red raspberry planting. The last two summarize the costs and yield of intermediate production years (year 2005 and 2006) for fall red raspberry planting. Summary for a mature (more than 3-year-old) production year is not currently ready, as we know that raspberry plantings should fruit for at least 6 years. A mature planting can expect higher receipts and harvest costs than the intermediate production years.

The following budget scenario is based on an example of growing raspberries in a tunnel (30 X 96 ft) with the formation of four rows, 90 feet in length and 7 feet between-row spacing at Cornell University in Ithaca New York. In year 2003, this high tunnel was erected, and the tunnel structure, lumber, and irrigation equipment are assumed to be amortized over 10 years and the cover over three years. An appropriate charge for construction labor was allocated to the establishment costs. Costs involved in year 2004 are primarily those related to planting, and installation of a trellis and irrigation system. There is annual replacement of the row cover and

drip irrigation. Trellis construction included seven 8' metal posts per row. There are two 32" crossbars per metal post. A total of 144 bare root stock plants of "*Heritage*" fall fruiting raspberries were purchased for $1.20 each. Under this high tunnel system, raspberries were planted directly to soil, with 36 plants per row, in-row spacing of 2.5 inches.

The production costs for growing period in year 2005 and 2006 include the fertilization costs, pest management supplies, monitoring and ventilation labor, and other cultural practices. Harvesting costs include paying the picker $0.50 per half-pint piece work, and $0.10 for the cost of each half-pint container. The fall-fruiting varieties could begin fruiting as early as in early July. Depending on the weather conditions for the autumn season, it may be possible to extend the fall-fruiting crop into November, or even December in some climates. Of the later maturing cultivars, *Heritage* is the industry standard. It produced a good yield of nice, but small, berries. First picking of *Heritage* raspberry is usually happen in August. The total yields are listed for the first two fruiting years, realizing 2,254 pints in 2005, and 1814 pints for the following year. Fresh-use berries are direct marketed through a farm stand for a price of $2.75 of each half-pint or $5.00 of each pint.

A on-line publication incorporating the recent budget for in-ground high tunnel fall-fruiting raspberry production in New York (Cathy Heidenreich, Marvin Pritts, Mary Jo Kelly., and Kathy Demchak, page 25-30, 2008) is available at
http://www.fruit.cornell.edu/Berries/bramblepdf/hightunnelsrasp.pdf

Estimated Establishment Costs and Costs of Production for Raspberry, 2003-2006

Year 1: Site preparation (2003)

Fixed costs: construct tunnel	**Unit**	**Quantity**	**$/Tunnel**	**Expected Life**	**Annual Cost**
Nor'easter greenhouse	package	1	6405	10	641
80 lb concrete mix	Bag	4.6	55	10	6
Lumber		1	932	10	93
Exhaust shutters & door hinges		1	209	10	21
Storm door		1	122	10	12
Misc hardware	Mixed	1	118	10	12
Labor	hr	166	1660	10	166
Tufflite Infrared polyethylene covering	roll	0.4	131	3	44
Total			**9632**		**995**

Pre-planting	**Input**	**Unit**	**Quantity**	**Price**	**$/Tunnel**
Soil test	lab test	sample	1	15	15
	labor	hr	0.5	10	5
Tillage, Land Preparation	machine	total	1	15	15
	labor	hr	4.5	15	68
Lime, compost, fertilizers, herbicides	material	total	1	50	50
	labor	hr	2	15	30
Total					**183**

Year 2 - Planting and Growing (2004)

Item	Input	Unit	Quantity	Price	$/Tunnel
Trellis					
8' metal post	material	ea	28	7.50	210
Pressure-treated 2" x 4" x 8'	material	ea	19	5.79	108
5/16" x 3" hex screw	material	ea	56	0.27	15
Flat washer	material	ea	56	0.06	3
5/16" hex nut	material	ea	56	0.07	4
Wire vise (5058V)	material	ea	32	2.35	75
High tensile wire *	material	per 1,000'	1.6	100	160
Pound posts	Labor	hr	11	15	165
Cut, drill, & install cross bars	Labor	hr	12	15	180
Install wire	Labor	hr	3	15	45
Total					**$966**
Irrigation system					
PVC coupling	material	ea	1	1.2	1
Disk filter	material	ea	1	24.2	24
Pressure regulator	material	ea	1	9.25	9
Poly pipe adapter	material	ea	1	3.7	4
3/4" poly pipe *	material	per 100'	0.3	28.8	9
Poly pipe reducing tee	material	ea	4	2.05	8
Poly pipe plug (3/4" insert)	material	ea	1	1.5	2
18 mm Drip In PC drip line	material	per 1,000'	0.4	271	108
Netafim line end	material	ea	4	0.18	1
Teflon tape (1/2" x 260")	material	per roll	1	0.97	1
Hose clamp (1/2" x 1-1/4")	material	ea	4	1.85	7
Hose clamp (3/4" x 1-1/2")	material	ea	10	2.25	23
Install irrigation system	Labor	hr	1.5	15	23
Total					**219**
Operation					
Raspberry Planting	Bare root	plant	144	1.2	173
	Labor	hr	2.5	10	25
Fertilizer	(34-0-0)	lb	6	0.18	1
	Labor	hr	0.6	15	9
Straw mulch	Mulch	bale	8	3	24
	Labor	hr	2	15	30
Hand weed & hoe	Labor	hr	4	15	60
Rototill	Labor	hr	3	15	45
Monitoring & Ventilation	Labor	hr	12	15	180
Total					**547**

Year 3 – Production (2005)

Operation	Input	Unit	Quantity	Price	$/Tunnel
Production					
Cover tunnel	Labor	hr	6	10	60
Retighten cover	Labor	hr	4	10	40
Fertilizer	(34-0-0)	lb	12.8	0.18	2
	labor	hr	0.6	15	9
Leaf analysis	lab test	sample	1	23	23
	labor	hr	0.2	10	2
IPM	Yellow sticky cards	ea	48	0.30	14
	Blue sticky cards	ea	48	0.58	28
Scout	labor	hr	6	10	28
Apply Pesticide	Sevin 80 S	application	3	0.73	2
	Malathion 57 EC	application	3	0.28	1
	Savey 50 DF	application	3	2.41	7
	Labor	hr	3	15	45
Crop cover	Covers: 4 yrs life	per roll	0.67	241	40
	labor	hr	2	10	20
Prune	labor	hr	4	10	40
Narrow rows	labor	hr	4	10	40
Train canes to trellis	labor	hr	6	10	60
Hand weed & hoe	labor	hr	4	10	40
Monitoring & Ventilation	labor	hr	12	15	180
Total					**682**
Harvest					
Pint baskets	Container	ea	2254	$0.05	117
Pint shippers	Container	ea	188	$0.94	177
Plastic vented dome lids	Container	ea	2254	$0.05	115
Picking, Packing	labor	pint	2254	$1.00	2254
Total					**2663**

2005 YIELD	Yield (pt/tunnel)			Cumulative yield (pt/tunnel)		
Week	Fresh market	Processing	Total	Fresh market	Processing	Total
1	1.1	0.3	1	1.1	0.3	1
2	8.1	14.3	22	9.3	14.6	24
3	65.2	58.1	123	74.5	72.7	147
4	119.1	69.1	188	193.5	141.8	335
5	243.6	111.0	355	437.1	252.7	690
6	191.6	119.1	311	628.7	371.8	1,001
7	209.1	108.9	318	837.9	480.6	1,319
8	202.7	91.2	294	1,040.5	571.8	1,612
9	167.9	68.4	236	1,208.4	640.2	1,849
10	75.7	35.8	111	1,284.1	676.0	1,960
11	72.5	32.4	105	1,356.6	708.4	2,065
12	64.6	19.0	84	1,421.2	727.4	2,149
13	83.4	21.5	105	1,504.5	748.9	**2,253**

Year 4 – Production (2006)

Operation	Input	Unit	Quantity	Price	$/Tunnel
Cover tunnel	labor	hr	6	10	60
Retighten cover	labor	hr	4	10	40
Fertilizer	(34-0-0)	lb	19	0.18	3
	labor	hr	0.6	15	9
Leaf analysis	lab test	sample	1	23	23
	labor	hr	0.2	10	2
IPM	Yellow sticky cards	ea	48	0.30	14
	Blue sticky cards	ea	48	0.58	28
Scout	labor	hr	6	10	28
Apply Pesticide	Sevin 80 S	application	6	0.73	4
	Malathion 57 EC	application	6	0.28	2
	Savey 50 DF	application	6	2.41	14
	Labor	hr	6	15	90
Crop cover	Covers: 4 yrs life	per roll	0.67	241	40
	labor	hr	2	10	20
Prune	labor	hr	6	10	60
Narrow rows	labor	hr	4	10	40
Train canes to trellis	labor	hr	6	10	60
Hand weed & hoe	labor	hr	4	10	40
Monitoring & Ventilation	labor	hr	12	15	180
Total					**758**
Harvest					
Pint baskets	Container	ea	1814	0.05	94
Pint shippers	Container	ea	151	0.94	142
Plastic vented dome lids	Container	ea	1814	0.05	93
Picking, Packing	labor	pint	1814	1	1814
Uncover tunnel, clean up	labor	hr	4	15	60
Total					**2203**

2006 YIELD	Yield (pt/tunnel)			Cumulative yield (pt/tunnel)		
WEEK	Fresh market	Processing	Total	Fresh market	Processing	Total
1	0.6	1.0	2	0.6	1.0	2
2	4.6	18.3	23	5.2	19.3	25
3	18.3	34.5	53	23.6	53.8	77
4	54.8	25.8	81	78.3	79.6	158
5	180.2	31.4	212	258.6	111.0	370
6	317.8	34.5	352	576.4	145.5	722
7	302.7	40.3	343	879.1	185.8	1,065
8	236.5	55.7	292	1,115.6	241.5	1,357
9	203.3	59.3	263	1,318.9	300.7	1,620
10	79.4	23.0	102	1,398.3	323.8	1,722
11	71.7	20.0	92	1,470.0	343.8	1,814

PART II. MARKET PRICE STUDY REPORT

The purpose of this marketing study is to study market price variation and identify marketing windows for selected high tunnel crops, including tomatoes, English cucumber, raspberries, sunflower, and lisianthus. Growers have several marketing options, including direct markets, produce auctions, cooperatives, local wholesalers, direct store deliveries, chain stores, terminal market brokers, etc.. During the study period (2006 and 2007 growing seasons), we collected weekly fresh market prices for the selected crops. The market prices collected were retail prices surveyed at a farmers' market and several supermarkets in Ithaca, New York and terminal market wholesale prices as gathered by the Agricultural Marketing Service (AMS), a division of the United States Department of Agriculture (USDA).

We surveyed weekly prices at three major supermarket chains in the Ithaca area, including Wegmans, P&C, and Tops, and the Ithaca Farmer's Market located in Steamboat Landing, Ithaca New York from June to September in 2006 and 2007. The surveyed data at the farmers' market and supermarkets represent retail prices directly paid by consumers. Terminal market data reflect prices paid by wholesalers based on trading at the New York terminal market for tomatoes, English cucumber, and raspberries and at the Boston terminal market for fresh-cut sunflower, and Lisianthus.

Tomatoes and English Cucumber Price Analysis

We collected the wholesale vegetable prices on the New York terminal market for the vine ripe varieties of greenhouse tomatoes and the long seedless varieties of greenhouse English cucumbers. Tomatoes packaged in 5-kg cartons were offered by suppliers from New York, Texas, California, Colorado, and Canada; film-wrapped English cucumbers packed in flats/cartons were supplied by Canadian companies. In addition, we surveyed weekly retail prices of the same classifications of tomatoes and English cucumbers at the three supermarket chain stores stated above in Ithaca, New York. Retail prices received at the Ithaca Farmer's Market were obtained from a specific booth that consistently sold both greenhouse tomatoes (beefsteak variety) and English cucumbers (not packaged in a tight wrap of plastic) throughout the summer season in 2006 and 2007. The data on wholesale prices, as well as data on local retail market prices, provides partial views of price trends that can help high tunnel growers set marketing analysis and marketing plan.

Tomatoes

Figure 1 shows the wholesale prices of tomatoes from the terminal market. Tomato prices may vary due to transportation costs, quality or weather conditions in both supply and demand sides, causing either excess supplies or shortages. As a result, wholesale prices fluctuated during the year. Canadian greenhouse tomato production (mainly from Ontario) was a market force in the wholesale market during the March to December period in the New York terminal market. The

northeastern U.S. greenhouse tomatoes had almost the same production period as Canadian products. The U.S tomato producers have to compete with the high Canadian summer volume.

The winter supply on the terminal market include large volume of supply from Mexico and other States such as Texas, Colorado, and coastal southern California, capturing a slice of the higher-priced winter market. The lowest wholesale tomato prices were reported in June to August, as field tomato supplies are typically abundant. High tunnel production can help New York tomato growers extend their supply season at both ends of the season and capture the market window with higher prices. The average wholesale tomato prices per pound were $0.64 in 2006 and $0.73 in 2007 for Canada imports (medium size), $0.56 in 2006 and $0.58 in 2007 for New York supplies (small-medium size), and $0.64 and $0.71 for crops from other States (medium size).

Figure 2 presents the average tomato retail prices surveyed at supermarket chains and the farmer's market. Retail tomato prices in supermarket stores fluctuated with a range from $1.49 to $3.99 per pound during the survey period, while the offerings at the farmers' market were sold at a steady price range around $2 -$2.4 per pound. Wegmans provided consistent year-round greenhouse tomatoes and English cucumber at competitive price from July to September, around $1.49 -$1.99 per pound and $1.5-$1.99 per each respectively. P&C and Tops usually sold at a higher price than Wegmans. Retail tomato prices were dramatically higher in the months before early June and after late September at the survey supermarket locations. Local tomatoes (as in the farmers market) were less available at that time. That could be a market opportunity for local high tunnel producers.

English Cucumbers

Figure 3 shows the wholesale price of English cucumber each at the terminal market. The supplies were solely from Canada. Wholesale prices of greenhouse English cucumber were reported in a range of $0.93-$1.4 each in 2006 and $0.58-$1.5 each in 2007. There is not a distinctive price window. However, both years (2006 and 2007) had the same price fluctuation pattern. That could be due to the production cycle of the Canadian greenhouse English cucumber suppliers. Figure 4 presents the average of supermarket prices and the farmers' market prices per English cucumber. The retail prices had little fluctuation. For example, Wegmans provided a consistent year-round English cucumber pricing of $1.5-$1.99 each from July to September. The prices offered at Farmers market were generally lower than prices at supermarkets. That presents an opportunity for producers selling at farmers markets to charge a higher price for quality product.

The average wholesale price for English cucumbers is $0.90 each in 2006 and $0.84 each in 2007 during the period from June to October. English cucumber prices in supermarket stores were usually between $1.50- $1.99 each during the survey period, while the offers at the farmers' market were sold at lower prices of around $1.0 -$1.5 each during the market season.

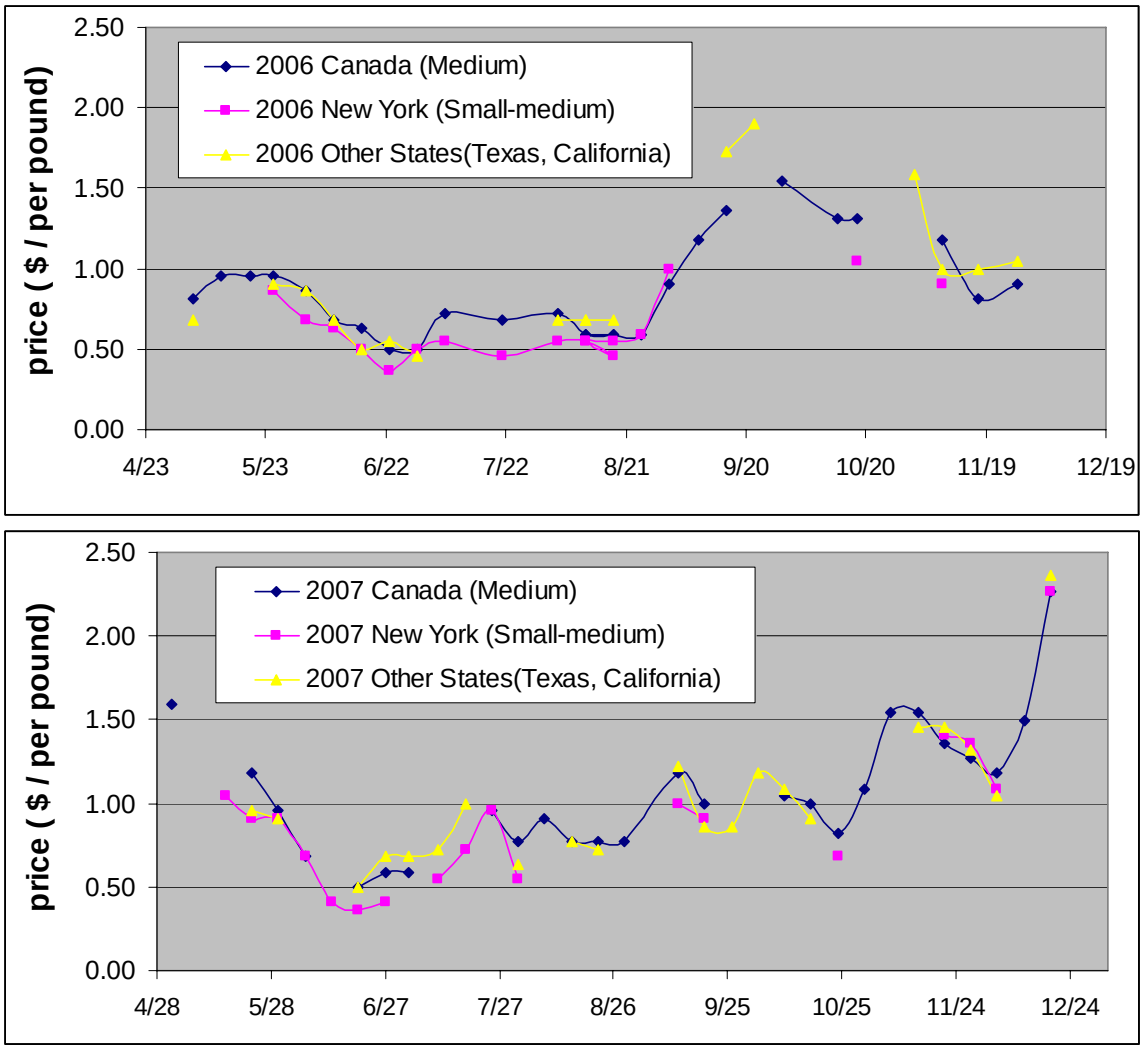

Figure 1: Tomatoes Prices at the New York Terminal Market, 2006-2007

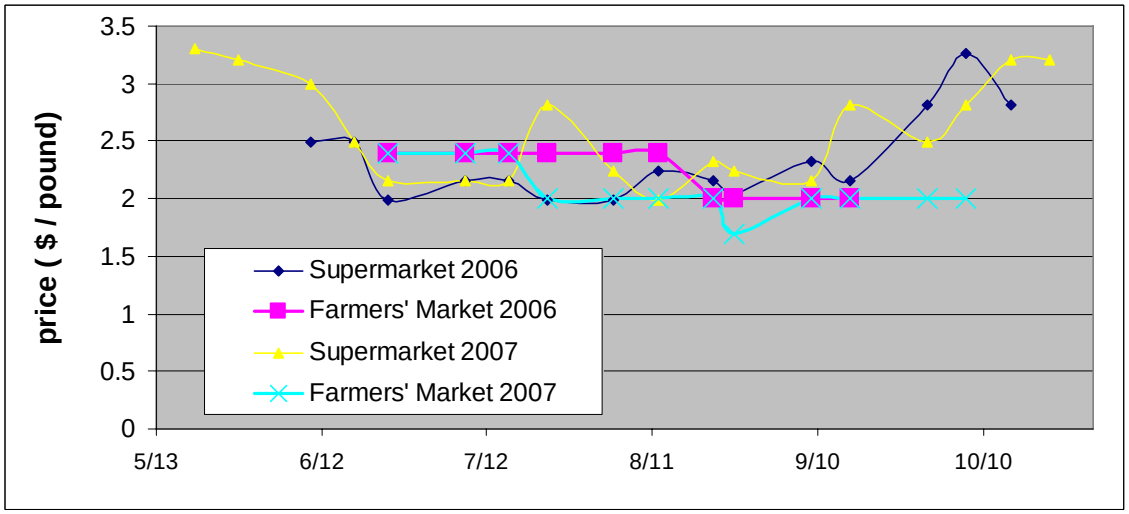

Figure 2: Tomatoes Prices at the Surveyed Supermarkets and Farmers' Market in Ithaca New York, 2006-2007

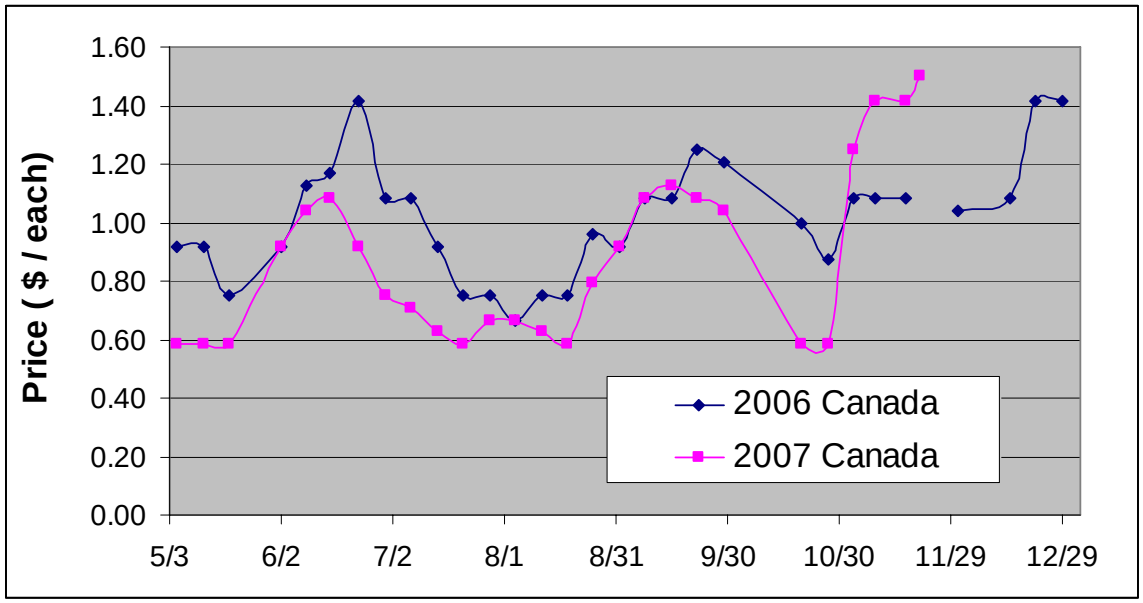

Figure 3: English Cucumber Prices at the New York Terminal Market, 2006-2007

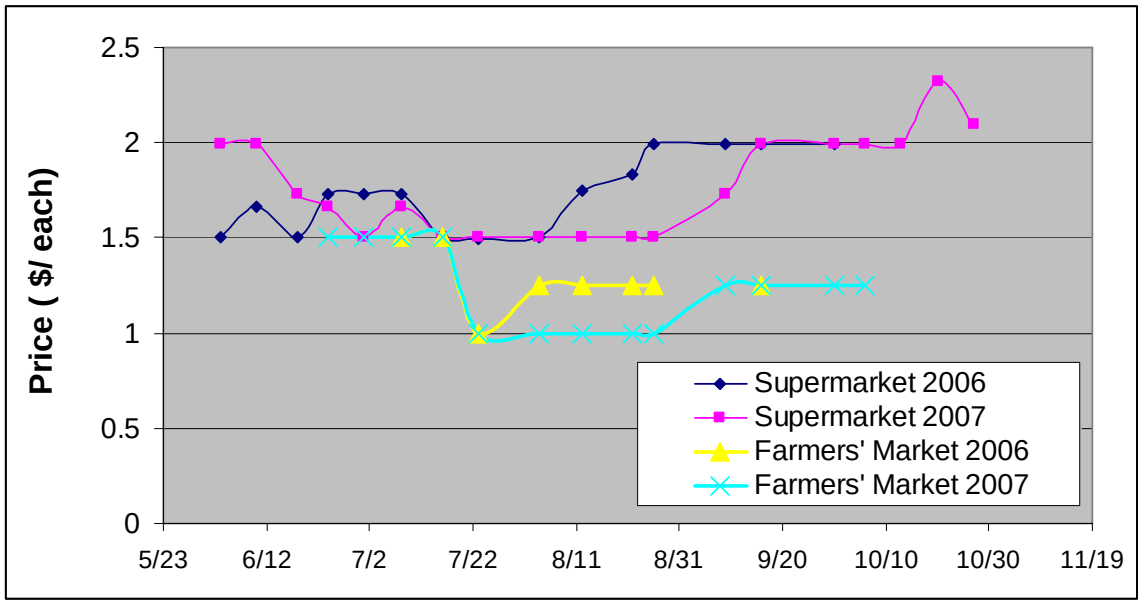

Figure 4: English Cucumber Prices at the Surveyed Supermarkets and Farmers' Market in Ithaca, New York, 2006-2007

Finally, this study also collected the auction prices of high-tunnel tomatoes and English cucumbers at Finger Lakes Produce Auction from June to November, 2006 (Figure 5). The auction prices were volatile, depending on the both demand and supply sides as well as the quality of supply on the particular auction day. Because the prices presented to us did not include the amount of supply, number of buyers, or quality of supplies at any given day, auction market prices did not appear to be reliable information for judging trends and marketing windows.

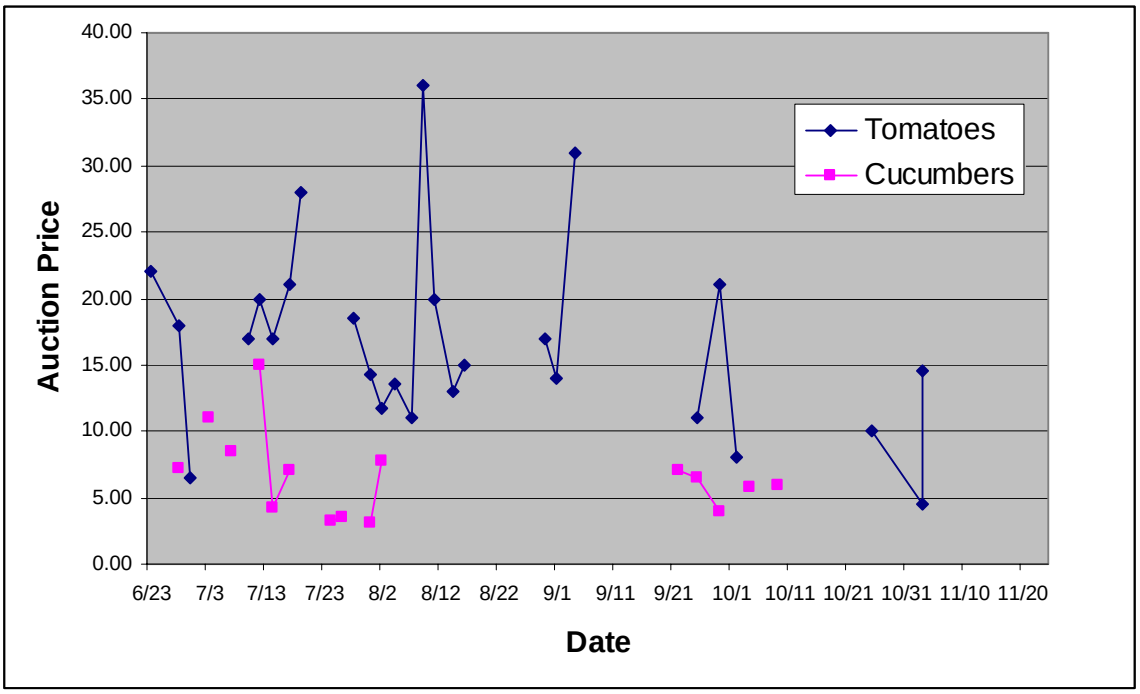

Figure 5: Prices of High Tunnel Tomatoes (25 lbs) and English Cucumbers (Half Bushel) at the Finger Lakes Produce Auction in 2006.

Sunflower and Lisianthus Market Price Analysis

Growers of cut flowers can generally gain reliable, regional wholesale market price information from the on-line terminal market price report. The weekly wholesale prices for sunflowers and lisianthus in the 2006-2007 period were reported by the Boston terminal markets from major producers around U.S. and the world, including New England, New Jersey, California, Florida, Ecuador, Canada, Netherlands, and Israel. This report collected sunflower prices of the per-stem package for varieties catogorized as Large Head Varieties on the terminal market report (Figure 6), and the lisianthus prices were based on the bunched-10s packages in the report (Figure 7). The terminal wholesale prices were not available for sunflowers from January to mid-June in 2006 and after late November in 2007. Also, no price data for lisianthus are listed between February and mid-June in 2006. This is because the information had not yet been released at report time, or the commodity with the values specified is not in season or has not been reported.

The terminal wholesales market prices for sunflower were pretty steady in both 2006 and 2007. Prices ranged from $1.0 to $2.0 per stem. Among various sunflower production origins, Netherlands received the highest wholesales price of $2.0 per stem. Ecuador producers provided consistent year-round supply at competitive prices around the average of $1.2 per stem. The domestic supply for sunflower was mainly offered by New England and New Jersey in 2006 but was largely replaced by Florida and California in the 2007 Northeast growing/marketing season between April to September. The average of wholesale domestic sunflower price was the lowest for “local producers” - $1 per stem for New England, $1.6 per stem for New Jersey, and $1.35 per stem for both Florida and California.

The Boston terminal market price report didn’t include any lisianthus supply from the Northeastern states. Lisianthus prices fluctuated slightly around Jun, 2006 and April- June 2007. Otherwise, the wholesales market prices for lisianthus were quite steady as well. The domestic supply mainly came from California. California producers received the average price of $13.3 for 10-stem bunches in 2006 and $12.6 in 2007. Also, prices received are higher in August and September. Ecuador, Israel, and Netherlands provided consistent year-round supply at competitive prices around the average of $12-$13 per 10-stem bunches.

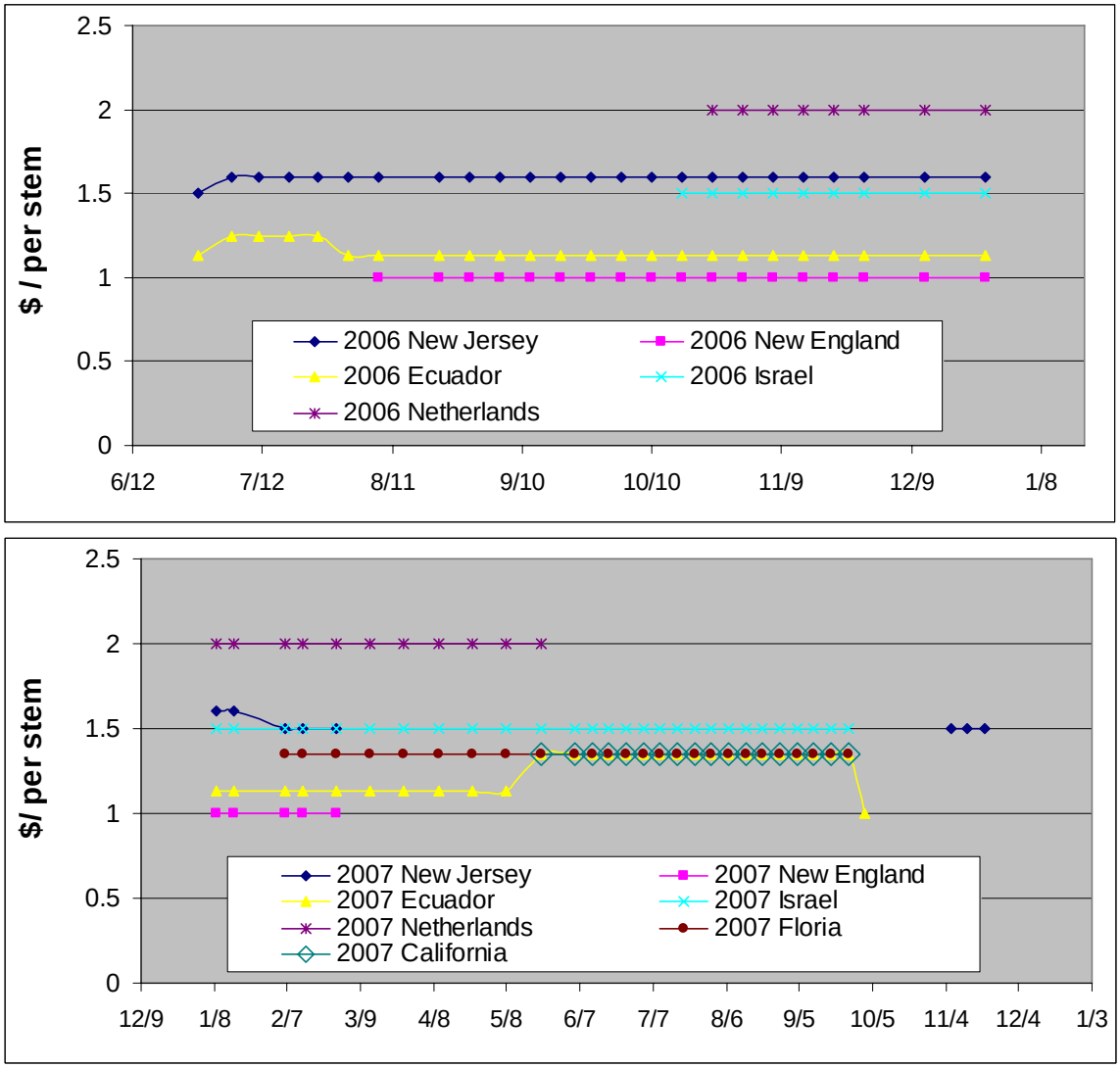

Figure 6: Sunflower Prices (Package: *per stem*; Category: *Large Head Varieties*) at the Boston Terminal Market, 2006-2007

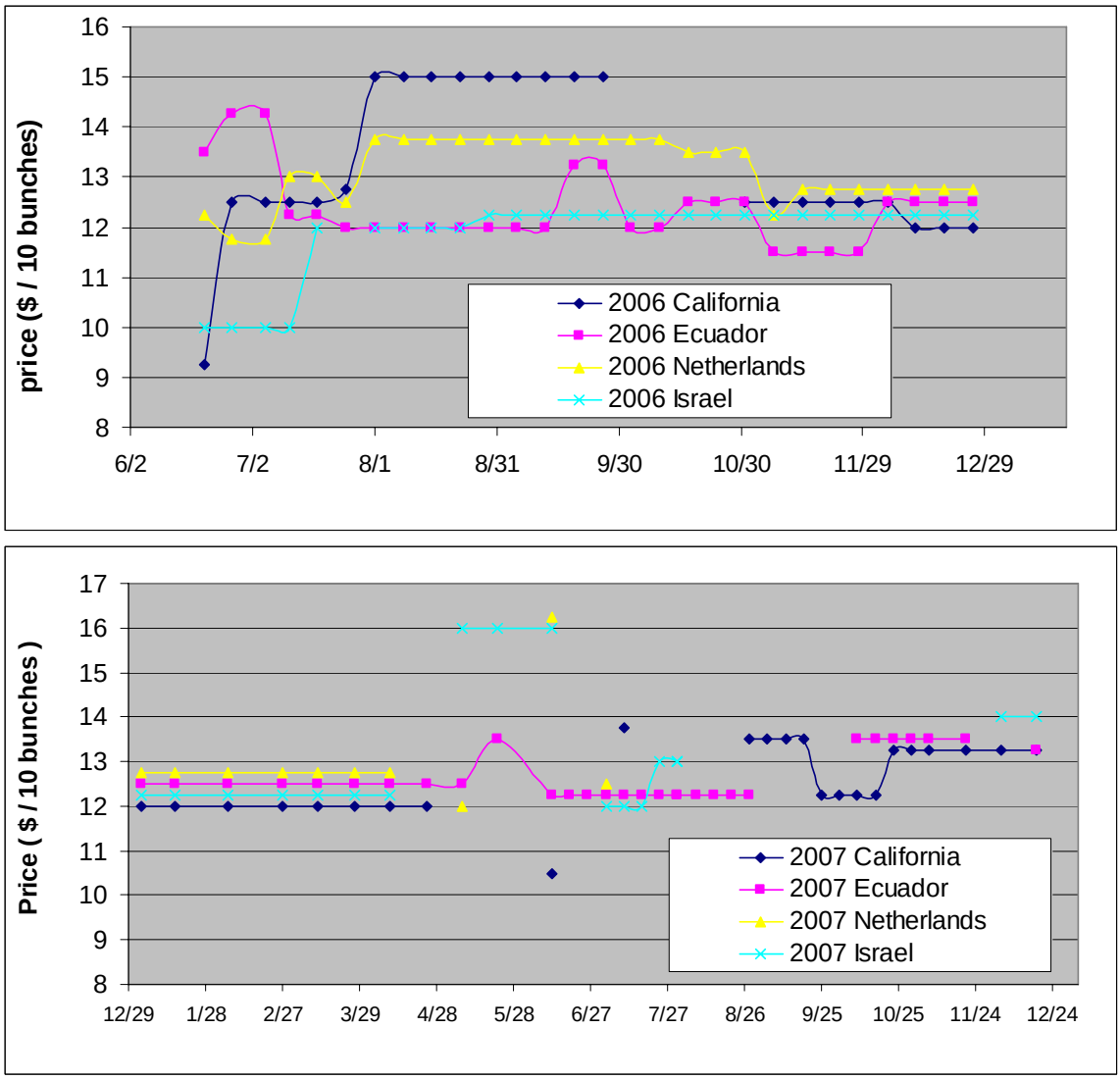

Figure 7: Lisianthus Prices (Package: *bunched of 10s*) at the Boston Terminal Market, 2006-2007

There were two cut flower booths at the Ithaca Farmers' Market, but one only sold flowers in the form of mixed species bouquets. Also, P&C and Tops only sold bouquets. It is not possible to estimate prices of sunflower or lisianthus individually separate from other flowers in the mixed bouquets. Thus, the 2006 and 2007 retail prices of sunflowers and lisianthus were surveyed at Wegmans and one booth at the Ithaca Farmer's Market that provided the choice of single species flower bunches and single-stem flowers.

As expected the retail prices at both the farmers' market and the supermarket were higher than the wholesale prices surveyed. Figure 8 summarizes weekly local sunflower retail prices in 2006 and 2007. Wegmans sourced the high-quality, long-stem sunflowers from New York local growers during the growing season. One of the growers also offer her equally high quality sunflowers at the farmers' market. The flowers were sold mostly at the price of $2.99 per stem at Wegmans, while prices at the farmers' market are typically about $ 2 per stem.

Small flower bunches of lisianthus were offered at Wegmans and the farmers' market occassionally, but not available on a weekly basis. Wegmans sold an average price of $1.70 per bunch in 2006 and $2.30 in 2007, while the average price of Lisianthus was $1.60 in 2006 and $2.10 in 2007 at the farmers' market.

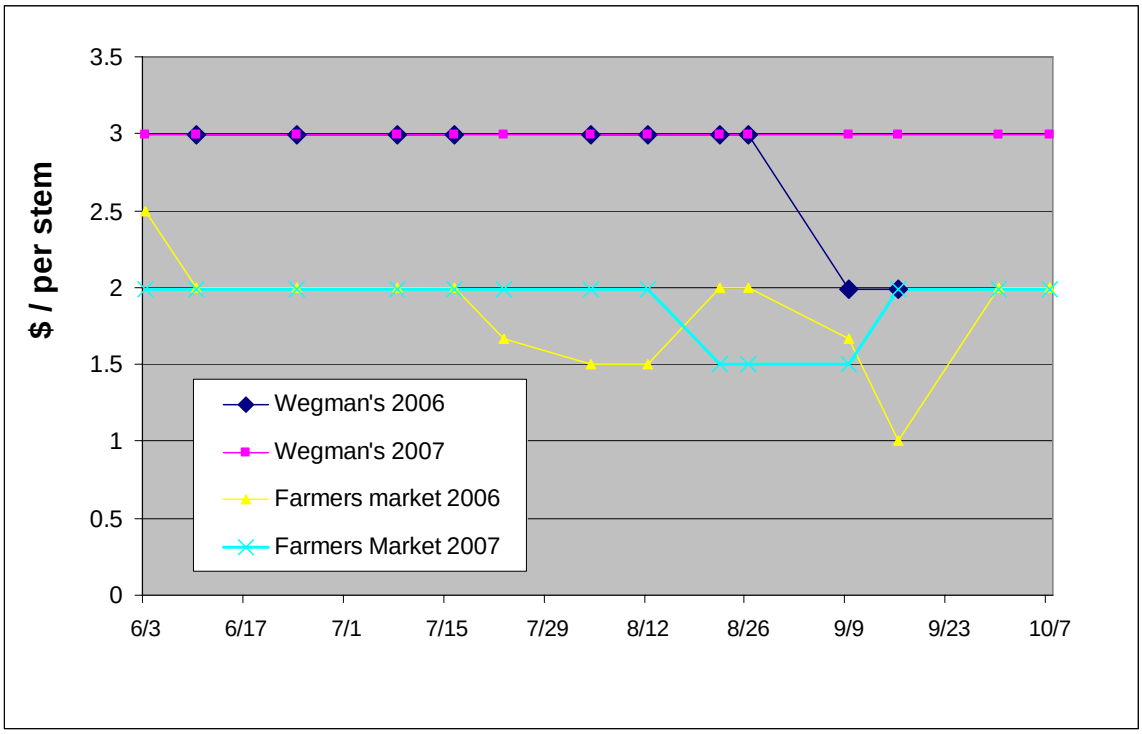

Figure 8: Weekly Sunflower Prices Surveyed from June to October, 2006-2007 at Wegmans and the Farmers' Market in Ithaca, New York.

Raspberry Market Price Analysis

Figure 9 summarizes red raspberry prices at the New York terminal market in 2006 and 2007. Also, Figure 10 shows the results of the raspberry price survey conducted at supermarket chains during June to October in 2006 and 2007. All prices within each market type were converted to a 6-oz equivalent price for the purpose of comparison, representing large fine appearance raspberries in the market.

Raspberries wholesale prices on the terminal market are subject to the greatest fluctuations, compared to those surveyed on supermarket chains and the farmers' market. Shippers generally sell and transport the wholesale raspberries for a predetermined price. Wholesale raspberries prices may fluctuate for reasons of changes in the domestic availability of the products itself or its demand substitutes. The best prices for raspberries fall to those arriving early (April-May) and appearing late (October-November) in the season. Wholesale prices of air-transported, fresh large red raspberries were typically $14-$30 for the package per flat 12 6-oz cups with lids from June to September. Raspberry production generally peak in July; prices in the peak season are the lowest, below $20 per flat or below $1.5 per 6-oz. Raspberries are mainly offered by California. Mexico shipped fresh-market red raspberries to the New York terminal market, starting in December until the next year in May.

Increasing local demand for raspberries has kept retail fresh-market prices relatively stable in these two years (Figure 10) Prices at Wegmans are consistently low between $2.5 and $2.99, while Tops charged a higher price at $3.49-$3.99. However, the P&C store surveyed in Ithaca New York didn't offer fresh market raspberries. Raspberries sold in Wegmans and Tops were mostly transported form California. Wegmans has been providing raspberries at the price as low as $2.5 per 6-oz all the year around since the beginning of 2007.

A short shelf-life product such as raspberries is well suited to farmers' markets, roadside stands, and U-pick operations. These direct marketing operations provide opportunities to receive higher than wholesale prices, although growers may have some additional marketing and operating expenses. This study doesn't provide the price information for roadside stand and U-pick marketing options. However, the survey results collected from a farmers market indicate that fresh raspberries were offered in the farmers' market only several times in July in these two years, at prices $4.5-$3.99 per half pint (8 oz) or $3.4- $2.8 per 6 oz. There is a great potential for local raspberry growers to add supply to their offerings at their own direct marketing outlets as well as other farm stands. More importantly, high tunnel raspberry production presents local growers the opportunity to tap into the higher price market window in the fall.

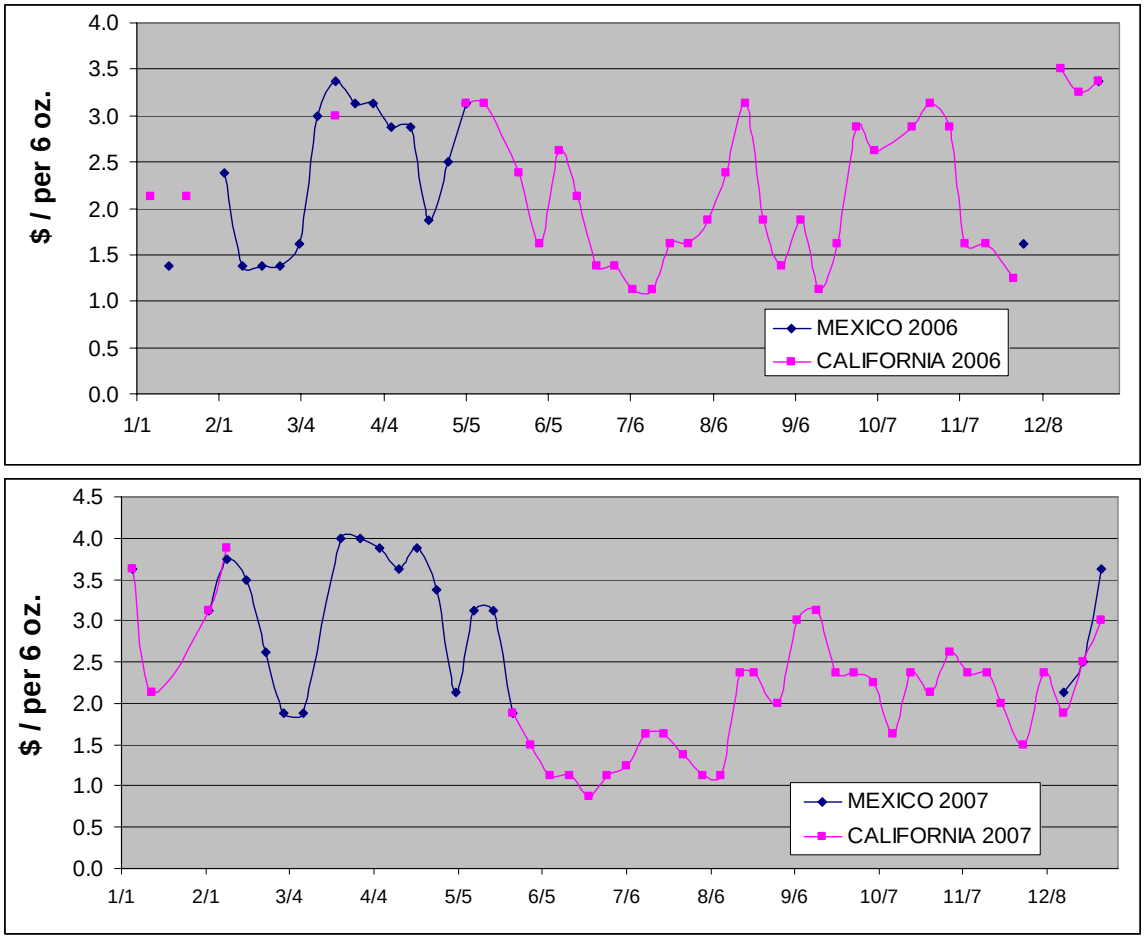

Figure 9: Red Raspberry Prices at the New York Terminal Market, 2006-2007

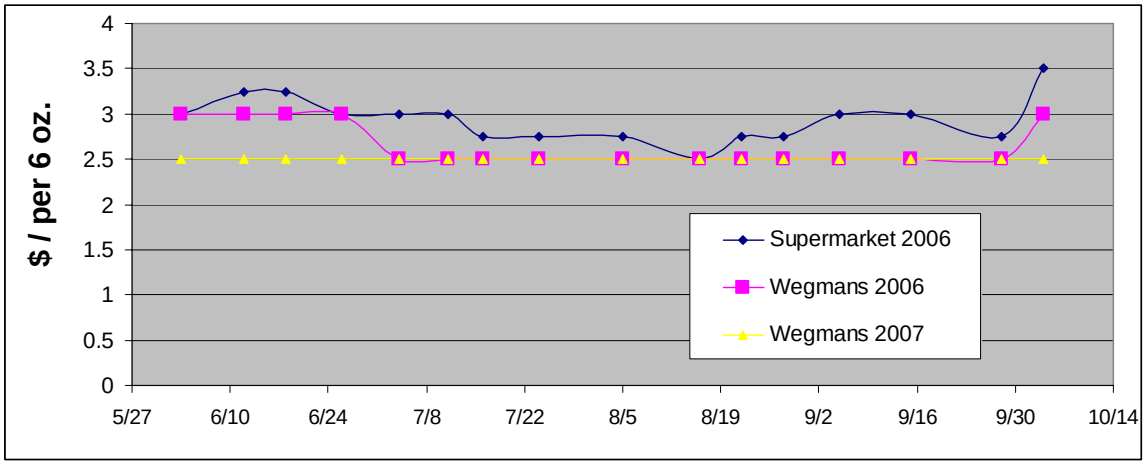

Figure 10: Red Raspberry Prices at Selected Supermarket Chains in Ithaca, New York 2006-2007