Investment Decisions and the Product Life Cycle - The Case of "Sunrise" Grapefruit in Israel

by

Arie Regev, Yael Kachel and Peretz Brosh*

Abstract

One of the major developments in Israeli citrus growing in recent years has been the increase in production of Sunrise grapefruit. This process entailed massive capital investment from private as well as public resources during a time period of about 20 years. Export quantities of Sunrise are still increasing while prices declined substantially since the mid-80's.

We are evaluating the investment decisions by comparing the investment in planting Sunrise to keeping an existing grove of white grapefruit. Our main findings are: (1) About one third of Sunrise plantations planted in the first part of the two decade period gained a positive and high Net Present Value, while the other two thirds planted later may end up with a very low or even negative NPV; (2) A variation of the product life cycle concept is identified in the development of Sunrise export sales. In the basic PLC concept sales volume and profits develop more or less parallel over time, while in Sunrise exports the time series of sales is delayed in comparison to profits; (3) These findings are explained by the perennial nature of citrus production with its long time lag from investment till the start of production.

Introduction

Red grapefruit of the variety Star Ruby (Sunrise) were introduced to the Israeli citrus industry in the second part of the 70's, a decade after the ordinary white "Marsh" grapefruit became a common product. Sunrise production grew rapidly in the 80's on account of other varieties with relatively low prices like white grapefruit. In recent years Sunrise prices decreased substantially, parallel to an increase in supply of pink and red grapefruit from Israel and other countries.

Growers all over the world base their investment decisions for perennial crops on current prices. Looking back today, it may be that many of the growers who invested in Sunrise while prices were still high, may have been better off keeping the variety

they were growing originally. We try to answer this question by comparing the investment in planting Sunrise to keeping an existing grove of white grapefruit. The concept of the product life cycle and its implications for investment decisions in perennial crops are discussed. It is argued that taking into account the product life cycle may improve the decision making process of growers.

Characteristics of the Variety

The Sunrise was developed in Texas in the late 50's under the name "Star Ruby". It is a mutation created by radiation of seeds of another grapefruit variety named "Hudson". Its peel as well as the flesh of the fruit has a characteristic red color. The variety was released for proliferation to other countries in 1970. The name "Sunrise" is a brand name used for this variety by the Israeli citrus industry.

The Sunrise has the following characteristics:

The fruit flesh is deeply red. Its internal color is the most intensive among colored grapefruit varieties. The color is not influenced by temperature or change of season (Shalom et al., 1996).

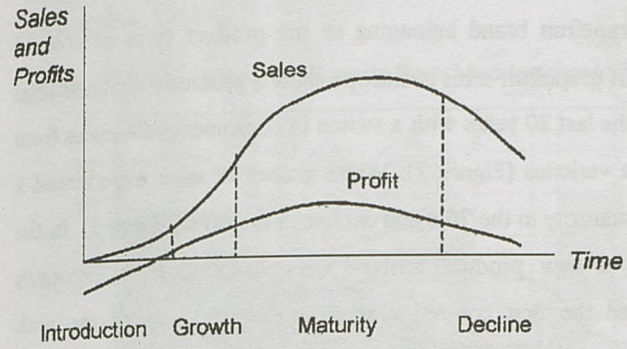
- The color of the peel is a noticeable red from the early stages of ripening (Shalom et al., 1996).
- The fruit is virtually seedless, occasional seeds are rarely found.
- The peel of the fruit is usually thin (although its thickness is influenced by the location of the grove), and as a result, the juice content is generally high.
- In countries with a warm climate the fruit is generally less bitter than the ordinary white seedless Marsh grapefruit.
- The Sunrise fruit is smaller than other grapefruit varieties and therefore reaches the suitable size for marketing later in the season (Greenberg et al., 1988; Shalom et al., 1996; Krammer et al., 1995; Gefen et al., 1996).

From the early 80's onwards, the Sunrise was planted extensively in Israel. The area of Sunrise groves reached more than 1,200 hectares in the mid-80's, 2,500 hectares in the early 90's, and it is estimated that the current area (in 1997) is 3,500 hectares.

Product Life Cycle of Israeli Sunrise Grapefruit

The product life cycle (PLC) is a marketing concept describing the sales pattern of a product over time. The sales history of a typical product is portrayed as an S-shaped curve, divided into four stages (Lilien et al., 1992; see Figure 1). *Introduction* is a period of slow growth as the product is introduced into the market. In the *growth* period more and more consumers are buying the product and profits are growing substantially. As the product moves from *maturity* to *decline*, sales and profits fall.

Figure 1: The Product Life Cycle



Understanding the concept of the PLC can help growers and traders of citrus fruit in their decision making. The stage of the life cycle for different citrus varieties should be identified because of its implications for marketing strategy and investment decisions. For evaluating the profitability of long term investments an indication on the expected length of the life cycle and the duration of the different periods may be helpful.

The empirical evidence on the existence of the life cycle model is mixed. Research results show that product forms (e.g., white grapefruit versus colored grapefruit) often develop according to the life cycle model, but that it is difficult to identify the life cycle for brands of products in practice (Urban and Hauser, 1980). This is because the PLC is no predetermined process each product has to pass but it can be influenced by marketing tools. In addition, the length of the stages may vary widely from product to product. Rymon et al. (1987) analyzed the market for spray carnations. According to their estimation results sales pattern of the product form as a whole as well as sales pattern of single cultivars are showing the typical characteristics of the PLC. The

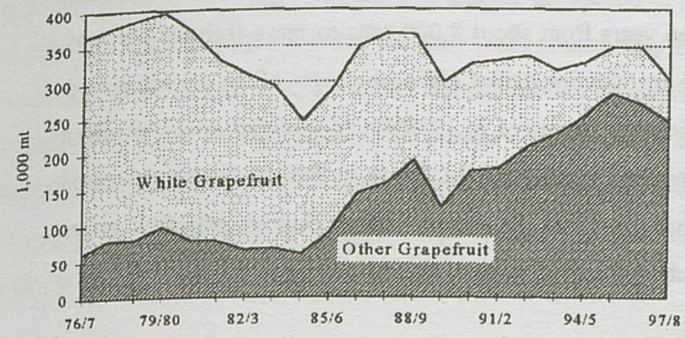
length of the PLC for spray carnations is estimated to be about 39 years. For an individual cultivar the duration of the PLC is about 15 years. Rymon (w.o. year) extended the research to other flowers and found again a good conformation to the theoretic form of the PLC.

We apply the concept of the product life cycle to exports of Israeli Sunrise grapefruit. It is investigated if the PLC is an appropriate tool for describing the development of export sales of Sunrise. The stage of the PLC is identified and its implications for marketing are discussed.

The Israeli Sunrise is a grapefruit brand belonging to the product form of colored grapefruit. Historical data of grapefruit sales in Europe show a relatively constant total grapefruit consumption in the last 20 years with a switch in consumer preferences from white to colored grapefruit varieties (Figure 2). White grapefruit sales experienced a growth period in the 60's, maturity in the 70's and decline in the 80's (Figure 3). In the 70's colored grapefruit - a new product form - were introduced to European consumers. Florida supplied the first colored grapefruits, which were of the pink variety "Red Blush". Mainly because of climatic conditions, these grapefruit were sweeter, more juicy and without the bitterness of the white Mediterranean grapefruit common in European markets at this time. Supplies from Florida quickly increased until a major freeze in December 1989 destroyed part of the production (Figure 4). After the freeze, exports from Florida to Europe stagnated for a number of seasons before increasing again.

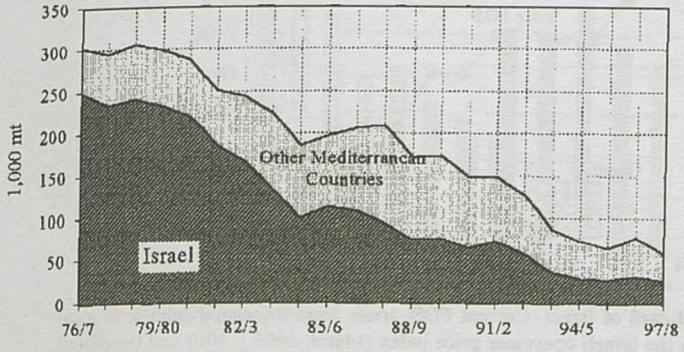
Israel, and other citrus growing countries, observed the success of Florida pink grapefruit in European markets, and introduced an additional colored grapefruit variety. Israeli Sunrise grapefruit has different characteristics compared to Florida pink grapefruit. The outside appearance of the Sunrise is more attractive with a stronger color and a cleaner skin. Acidity levels of the fruit are higher, but part of the fruit - depending on the time of the season and the growing area in Israel - can reach similar maturity levels as grapefruit from Florida. Consumer studies show that in this case most consumers prefer the Sunrise grapefruit on the Florida pink grape(Goldman and Givon, 1985; Rosenbaum, 1984). These observations suggest that the Sunrise is a differentiated product with sales developing according to a brand-specific life cycle.

Figure 2: Grapefruit Exports from Mediterranean Countries and the United States to Western Europe



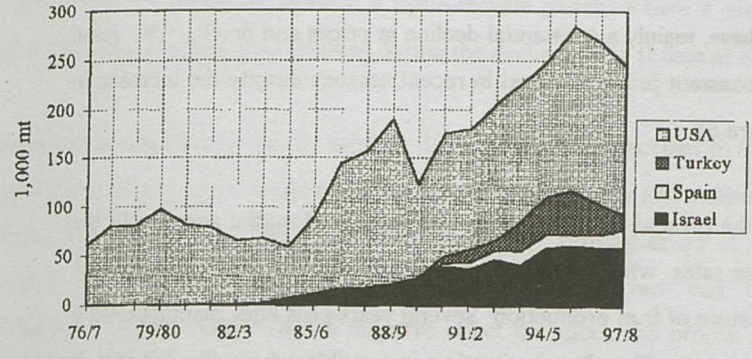
Remark: "Other Grapefruit" are mainly pink and red grapefruit.
Data source: CLAM

Figure 3: White Grapefruit Exports from Mediterranean Countries to Western Europe



Data source: CLAM

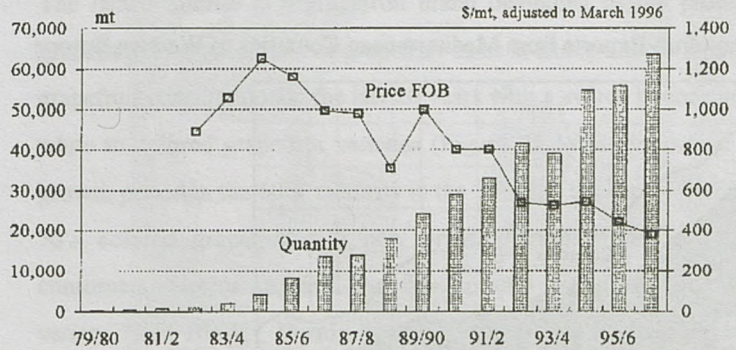
Figure 4: Colored Grapefruit Exports from Mediterranean Countries and the United States to Western Europe



Remark: Most of the grapefruit exported from the USA to Europe are from Florida
Data source: CLAM

Exports of Sunrise from Israel commenced around 1980 (Figure 5). In the introduction period just small quantities were exported. Sales started to take off around season 1985/86 and increased in ten years from about 8,000 tons to more than 60,000 tons. Prices were very high in the introduction period and at the begin of the growth period. The first substantial price decrease occurred in 1988/89. In 1989/90 prices increased again. This season is exceptional because of the freeze in Florida, which decreased drastically the supply of pink grapefruit. In recent seasons Sunrise grapefruit prices were relatively low, approaching the price level of regular white grapefruit.

Figure 5: Israel - Exports of Sunrise



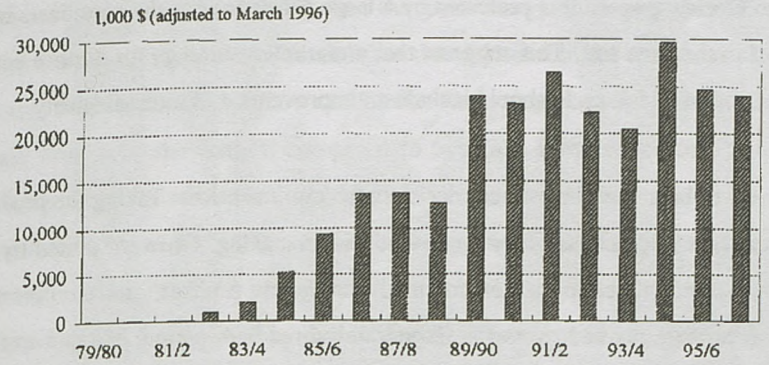
Data source: Citrus Marketing Board of Israel. Current FOB prices were translated from $ to local currency (NIS), time adjusted by the Israeli consumer price index (March 1996 = 100) and translated back to $ (exchange rate of March 1996).

According to the data on export quantities the Sunrise is still in the growth stage. On the other hand, there are several symptoms indicating that the Sunrise is reaching already the maturity phase, mainly a substantial decline in prices and profits. The value of Sunrise exports in constant prices declined in recent seasons despite the increase in export quantities (Figure 6).

The basic concept of the product life cycle does not seem to describe adequately the development of Sunrise sales, when export quantities are evaluated. The discrepancy arises because of the nature of fruit production. Several years pass after planting until a fruit tree starts to yield fruit. Therefore a situation is possible where the product is already passing to the maturity period but there are still young groves starting to yield, increasing production in the maturity stage. The investment in a grove becomes a sunk

cost after plantation, hence growers will continue growing if they cover their variable costs and they have no better alternative to employ the factors of production they own. In addition, many growers will not cut their trees immediately even when prices are lower than variable costs. The reason for this inflexibility in adapting production to the stage in the life cycle is incomplete information - growers may assume that the price decline is just temporary. As a result, perennial crops may suffer from larger price decreases in comparison to annual crops because of the difficulties to adjust production.

Figure 6: Israel - Value of Sunrise Exports



Additional problems in using the life cycle concept to forecast future sales are large variation in the length of each period from product to product and the possibility to influence the life cycle of a product by an appropriate marketing strategy. For example, a common form of the life cycle is a cycle-recycle pattern where a second hump in sales is caused by a promotional push during the decline phase (Lilien et al., 1992).

Nevertheless, the concept of the product life cycle is very important to citrus growers and traders because of its implications for investment behavior and marketing strategy. The maturity stage of a product is characterized by slowing-down of sales growth because the product reached most of the potential buyers and by increased competition. These factors have a negative effect on prices and profits. For Sunrise, prices declined already substantially in the last few seasons, eroding profits, especially at the farm level.

Increased competition calls for an effective marketing strategy to keep and increase the market share of Sunrise. An important element in such a strategy may be promotion. Successful promotion has to be based on a sound product strategy. As a first step positive and negative aspects of Sunrise have to be evaluated in relation to consumer wishes and characteristics of competing products. There is evidence that a majority of European grapefruit consumers today prefer pink grapefruit from Florida on Sunrise because of its sweeter taste. In most European markets the market share of Florida grapefruits exceeds the market share of Sunrise. In addition, Florida grapefruits attain generally higher prices. On the other hand, the consumer study conducted by Goldman and Givon shows, that Sunrise of "good" internal quality with a similar maturity standard to Florida grapefruit is preferred by a large percentage of the consumers who participated in the taste test. This suggests that a marketing strategy for Sunrise in the maturity period of its life cycle should include an improvement of internal quality.

Growers tend to base their investment decisions on current prices. Taking the product life cycle concept into account may improve decision-making. Growers should try to gather information about the market potential of the new product, and the potential supply from already planted groves in Israel and abroad. A period of rapid export growth accompanied by high prices may indicate that the new product is approaching the maturity stage, especially when prices started to decline. For citrus growers the right timing of investments is especially important because of the relatively long time lag from planting the grove until the first yields.

Investment Decisions of Citrus Growers

The product life cycle concept and its implications for grapefruit marketing were discussed in the last chapter. The linkage between the PLC, the timing of planting a grove along the life cycle of a certain variety and the pursuit of a reasonable investment return, from the individual point of view, will be analyzed in the current chapter.

It is assumed that investing capital in a citrus grove should be determined according to the same investment criteria like any other long-run project. Consequently we adopted

one of the most common criteria, the 'Net Present Value' (NPV). In order to use this criterion for a basic unit of investment (in our case one hectare) a few terms should be defined:

Life Time: The standard life time is 20 years. This norm is based on agro-technical, economic and PLC aspects.

Interest Rate: An annual discount rate of 5 percent is assumed.

Gross Margin: The annual surplus, obtained by subtracting harvesting and cultivation costs from the revenue at farm gate.

Cash Flow: A perennial series (20 years) of gross margin figures, from planting date (time point zero) up to the end of life time. This series includes the 'investment period', namely the first years when the gross margin is negative due to the fact that there is still no yield and no revenue, or the yield is still low and the revenue does not cover the costs. Two cash flows of Sunrise (assuming planting year 1983/4 for the first and 1993/4 for the second) compared to two cash flows of existing groves of white Marsh grapefruit will be analyzed later.

To determine the NPV of a certain cash flow, we have first to calculate the 'present value' of each individual gross margin figure (by multiplying it with the 'present value factor' which is computed by discounting with 'compound interest') and then to sum the entire series of discounted figures. The final result is a single figure, which represents the perennial surplus throughout the project's entire life time, in terms of 'present value'.

According to the practical experience of extension personnel, citrus growers in particular and fruit growers in general usually are thinking about grafting or replanting a grove whenever a new variety gains a higher market price thvarieties they grow. This was the situation in the early eighties, when the Sunrise variety was widely exposed to Israeli citrus growers. The most important question regarding the grower's decision making process is if and when the decision of planting a new variety instead of an existing one is justified.

In order to tackle this question we simulated two scenarios: one in which we assumed planting a hectare of Sunrise in 1983/4, compared to maintaining an existing hectare of white Marsh grapefruit. In the second scenario we assumed planting a hectare of

Sunrise in 1993/4, once again in comparison to Marsh grapefruit. In all four cases the investigated life time is 20 years, and the NPV criterion was computed for the Sunrise versus the perennial discounted gross margin of the Marsh. Before having the results we could no more than speculate whether the growers who planted Sunrise in the 80's gained a premium for being 'early adopters', and if those who planted in the 90's paid a fine for hesitating too long, and if it was justified at all to invest in Sunrise instead of keeping the existing variety.

Time series of grapefruit prices at farm gate were obtained from one of the leading Israeli citrus growing and marketing companies (Table 1; more details on data used and transformations performed can be obtained from the authors upon request).

Table 1: Grapefruit Price at Farm Gate
(in U.S. $ per mt, adjusted to March 1996)

Year	Sunrise	Marsh
1986/7	496.1	178.6
1987/8	529.4	167.3
1988/9	287.1	182.8
1989/90	520.7	167.6
1990/1	341.1	108.4
1991/2	336.2	142.1
1992/3	201.9	111.0
1993/4	171.2	126.2
1994/5	181.9	108.4
1995/6	154.0	105.5

Real grower prices decrease for both varieties, although the decrease is more dramatic in the case of Sunrise. There are not enough observations available for the life time scenario. Therefore we estimated a time trend of prices and selected the trend line with the best fit. The trend was used to forecast grapefruit prices for the seasons 1995/6 to 2003/4 as well as to estimate prices for 1983/4 to 1985/6 for which no data were available (Table 2)

The trend line representing the forecast of Sunrise prices carries on the dramatic fall of prices into the second half of the nineties. If this forecast would be realized, the farm gate price of Sunrise would be below $100 per ton by the year 2000. The price

forecasted for 1999/2000 is $87, yielding an on-tree price of $67.3 (calculated by subtracting picking costs of $19.7). Taking into account cultivation costs of $6,094 per hectare (see Table 5) means that it is necessary to reach a yield of 90.5 mt per hectare to cover costs. Such a yield is above the expected perennial average of about 70 mt per hectare.

The assumption we adopted for our scenarios is that the cash flow should not include prices where the annual variable costs (harvesting and cultivation costs including labor and management) are not covered. We decided to do so because the investment decisions of grapefruit growers should be evaluated assuming an ordinary life cycle, not one under conditions of crisis. Therefore we used interpolated data with prices identical to the estimated trend in the first part of the time series, and a constant price covering at least production costs in the second part (see Table 2).

The calculation of the NPV for one hectare of Sunrise, according to the first scenario of planting in the eighties, is presented in Table 3. The calculation results are: The net present value of the project, which is supposed to last for 20 years from 1983/4 to 2003/4, is $55,566. The annual variable costs are covered for the first time in the third season - 1986/7. The investment of $15,528 is covered in 1988/9 (a pay back period of five years).

For comparison we analyzed the same period of two decades for an existing hectare of Marsh grapefruit. The perennial discounted gross margin (similar calculation to that of the NPV) sums up to $43,987.

Comparing the investment in Sunrise to maintaining an existing grove of Marsh grapefruit in the second scenario (seasons 1993/4 to 2013/4), we find that the NPV for the Sunrise is negative, -$3,527. The annual variable costs are covered for the first time in the fifth season - 1998/9. Pay back period is not achieved. The perennial discounted gross margin for the Marsh is $4,540.

The calculation of the first scenario for Marsh grapefruit as well as the calculations of the second scenario are not presented here but can be obtained from the authors upon request. The calculations do not include a subsidy paid for planting a new grove of Sunrise. Taking into account the subsidy increases the NPV for Sunrise but does not change our basic results.

Table 2: Forecast of Sunrise and Marsh Grapefruit Prices at Farm Gate ($ per mt) - Trend Line versus Interpolation

Formula of the Trend Line: Sunrise $p = 635.9\ e^{-0.142t}$, $R^2=0.81$

Marsh $p = 0.414\ t^2 - 13.59\ t + 198.58$, $R^2=0.75$

	Sunrise		Marsh	
Year	Trend	Interpolation	Trend	Interpolation
1983/4	844.9	844.9	227.4	227.4
1984/5	733.0	733.0	212.6	212.6
1985/6	635.9	635.9	198.6	198.6
1986/7	551.7	551.7	185.4	185.4
1987/8	478.6	478.6	173.1	173.1
1988/9	415.2	415.2	161.5	161.5
1989/90	360.2	360.2	150.9	150.9
1990/1	312.5	312.5	141.0	141.0
1991/2	271.1	271.1	132.0	132.0
1992/3	235.2	235.2	123.8	123.8
1993/4	204.0	204.0	116.4	116.4
1994/5	177.0	177.0	109.8	109.8
1995/6	153.5	153.5	104.1	104.1
1996/7	133.2	133.2	99.2	99.2
1997/8	115.6	133.2	95.2	99.2
1998/9	100.3	133.2	92.0	99.2
1999/2000	87.0	133.2	89.6	99.2
2000/1	75.5	133.2	88.0	99.2
2001/2	65.5	133.2	87.2	99.2
2003/4	56.8	133.2	87.3	99.2
2004/5	49.3	133.2	88.2	99.2
2005/6	42.7	133.2	90.0	99.2
2006/7	37.1	133.2	92.5	99.2
2007/8	32.2	133.2	95.9	99.2
2008/9	27.9	133.2	100.2	99.2
2009/10	24.2	133.2	105.2	99.2
2010/11	21.0	133.2	111.1	99.2
2011/12	18.2	133.2	117.8	99.2
2012/13	15.8	133.2	125.4	99.2
2013/14	13.7	133.2	133.7	99.2
2014/15	11.9	133.2	142.9	99.2

Table 3: Perennial Cash Flow and NPV for an Investment of one Hectare of Sunrise Grapefruit Planted in 1983/4

Year	Yield	Price	Harvesting Costs	Revenue minus Harvesting Costs	Cultivation Costs	Gross Margin	Present Value of Gross Margin	Present Valuc Factor
	mt/ha	$/mt	$/mt	$/ha	$/ha	$/ha	$/ha	I. = 5%
1983/4					8570	-8570	-8570	1
1984/5					3284	-3284	-3128	0.952381
1985/6					4223	-4223	-3830	0.907029
1986/7	15	551.7	19.68	7980	3845	4135	3572	0.863838
1987/8	30	478.6	19.68	13767	4777	8990	7396	0.822702
1988/9	45	415.2	19.68	17798	4923	12875	10088	0.783526
1989/90	60	360.2	19.68	20430	5258	15172	11322	0.746215
1990/1	65	312.5	19.68	19032	5545	13487	9585	0.710681
1991/2	70	271.1	19.68	17598	6094	11504	7787	0.676839
1992/3	70	235.2	19.68	15085	6094	8991	5795	0.644609
1993/4	70	204.0	19.68	12904	6094	6810	4181	0.613913
1994/5	70	177.0	19.68	11012	6094	4918	2876	0.584679
1995/6	70	153.5	19.68	9371	6094	3277	1825	0.556837
1996/7	70	133.2	19.68	7947	6094	1853	983	0.530321
1997/8	70	133.2	19.68	7947	6094	1853	936	0.505068
1998/9	70	133.2	19.68	7947	6094	1853	891	0.481017
1999/00	70	133.2	19.68	7947	6094	1853	849	0.458112
2000/1	70	133.2	19.68	7947	6094	1853	808	0.436297
2001/2	70	133.2	19.68	7947	6094	1853	770	0.415521
2002/3	70	133.2	19.68	7947	6094	1853	733	0.395734
2003/4	70	133.2	19.68	7947	6094	1853	698	0.376889
						NPV =	55566	

Summary and Conclusions

Our calculations show that early adopters of Sunrise who planted a grove in the 80's enjoyed a positive net present value, which is considerably higher than the perennial discounted gross margin for an already existing grove of Marsh grapefruit. In the 90's, the NPV for investing in a Sunrise grove is negative according to our calculations and lower than the also quite presults for an existing Marsh grove. Only about 1,200 out of the 3,500 currently planted hectares of Sunrise existed already in the mid-80's. There is a high probability that a large percentage of the area planted afterwards, and especially investments made in the 90's, have to face a negative NPV.

The value of the product life cycle as a forecasting tool is limited because the development of sales for a product depends on decisions taken along its life cycle. The importance of the PLC concept is as a supporting means for decision making in marketing. From the point of view of the individual fruit grower it seems to be very important to try and identify the stage of the life cycle of a variety he would like to plant and not to base his investment decision solely on current prices. Data on the development of sales quantities may not be sufficient for identifying the stage of the life cycle for citrus varieties and other perennial agricultural products because of the delayed adaptation of production to changing market conditions. Therefore the development of prices should also be watched closely. For a successfully introduced perennial agricultural product prices are generally high initially because production is still small. A substantial decline in prices may indicate the approach of the maturity period with increasing competition and a slow down in demand growth. Because of the lag in adapting the production of perennial crops supply will continue to grow for some time and a larger price decrease should be expected compared to products which production can be adjusted easily.

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* Biographical Sketches of the Authors

Dr. Arie Regev

Deputy director for extension matters of the Central Region since 1993. Senior economist with the Extension Service for citrus production. Graduate in Agricultural Economics (M.Sc. Honors, 1986) of the Hebrew University of Jerusalem, and Doctorate (Ph.D., 1997) of the Hungarian Academy of Science.

Yael Kachel

Market researcher for citrus at the Department of Market Research, Ministry of Agriculture, Israel (since 1991). Study of Agricultural Economics at Kiel University, Germany (M.A., 1991). Doctoral Student, Hebrew University, Faculty of Agriculture - Department of Agricultural Economics.

Peretz Brosh

Senior citrus specialist. Member of the Department of Citrus Production - Extension Service, Ministry of Agriculture. In charge of the national citrus variety and rootstock selection. Graduate (B.Sc., 1960) of the Hebrew University of Jerusalem in Agriculture. Studies toward masters degree in Economics and Developing Countries (1974 - 1978).