Single Stem Roses -- An Economic Analysis

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Timothy Woods and Robert G. Anderson

University of Kentucky
Department of Agricultural Economics
400 Charles E. Barnhart Bldg.
Lexington, KY 40546-0276

Phone: 859-257-5762
Fax: 859-323-1913
http://www.uky.edu/Ag/AgEcon/

Timothy Woods may be contacted by e-mail at tawoods@uky.edu.

Single Stem Roses - An Economic Analysis[1]

Timothy A. Woods, *Department of Agricultural Economics*
Robert G. Anderson, *Department of Horticulture & Landscape Architecture*
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Abstract

The economics of an innovative long stem rose production system are examined as a specialized perpetual production system as well as as an enterprise integrated with other typical greenhouse products. Commercial quality cut roses can be grown in a single stem system from cuttings. Single stem roses grown in 6 to 10 cm containers can be grown on mobile trays with ebb and flood subirrigation to greatly reduce irrigation runoff. Marketable yields for the greenhouse space are significantly increased over conventional production systems, although capital costs and management intensity are also greater. This system allows the use of pot handling robots to reduce labor costs and the movement of the roses to specific controlled environments that are optimal for each stage of rose growth. Data from seven sequential crops of *'Lady Diana'* rose cuttings grown from February to May 1995, showed that rooting required a mean of 16 days, flower buds were visible in 42 days, flower harvest required a mean of 58 days and the mean stem length was 54 cm. Production costs within several enterprise schemes were determined for cut rose stems that met these mean characteristics as well as for the highest quality stems (66-75 cm long). Economic considerations integrating seasonal market prices, seasonal energy costs, special capital and labor costs etc. were included in the analysis. These variations led to break-even costs ranging from about $0.20 to $0.25 per stem. Estimated internal rates of return could be expected to be about 77% for specialized rose production under baseline production and average market conditions.. The IRR estimate increases to about 174% for seasonal rose production that is specifically targeted to the Valentines Day market when integrated with other greenhouse products over the rest of the year.

1. Introduction

Traditional techniques for greenhouse hybrid tea stem rose production were developed over 75 years ago and result in moderate overall productivity, with typical yields on the order of 200-350 stems per square meter (Pertwee, 1995; Durkin, 1992; Langhans, 1987). Traditional greenhouse rose production utilizes a fixed space for a period of 5 to 10 years because the rose shrubs are planted in the ground inside the greenhouse. Strong seasonal markets, together with high opportunity costs for roses occupying space that could be producing other greenhouse products, and the increasingly significant environmental costs, make this alternative production scheme potentially more attractive.

The primary market periods are three major U.S. holidays - Valentine's Day, Mother's Day and Christmas. Demand for roses is significantly higher during these periods. Wholesale terminal prices reported at the Miami Terminal Market reflect the tremendous seasonal swing in prices. Weekly AMS prices for 1996 are presented in Figure 1, reflecting typical seasonal patterns.

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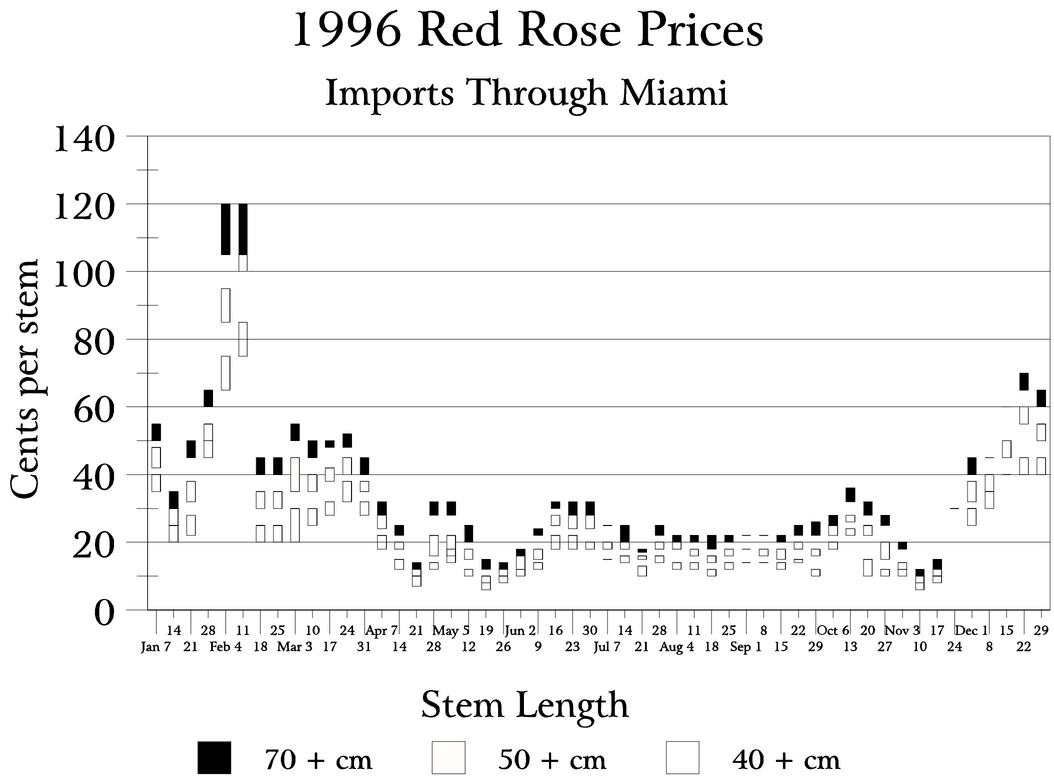
FIGURE 1



Hybrid tea roses, typically produced as long stem varieties with red and other assorted colors, are both capital and labor intensive. A greenhouse rose facility typically requires a substantial investment in both time and capital to begin cultivation of a given cultivar; changing cultivars can only be done by replacing existing mature plants with new immature stock. In order to have flowers for these peak market periods, the plants must be maintained year around in controlled environment buildings. Each rose plant must be visited by a worker once or twice a day, every day of the year, for flower harvest. Consequently, production costs are quite high, because labor must be used to harvest flowers every day of the year and thus to try to sell the flowers throughout the year, even when market demand is low. Of course, all other overhead and energy costs must be maintained for the calendar year as well.

The environmental costs for traditional rose production are just beginning to be defined. Roses are the most intense horticultural/agricultural crop in the world, with the highest fertilizer and pesticide use. Traditional production systems are open, so all fertilizer and pesticides are applied and travel to the greenhouse floor where they contaminate surface water and eventually ground water supplies. Hydroponic recirculating (closed) irrigation systems have been developed to reduce fertilizer pollution and are used extensively in Europe, somewhat in the U.S., but never in Central and South American production. The industry is making a major effort to change pesticide use, but the traditional production system prevents most change. Daily flower harvest always contends with pesticide application. For this reason, the recent Worker Protection Standard for greenhouse workers was given a six month delay for cut rose greenhouses. Environmental contamination, particularly groundwater pollution through the greenhouse floors, is expected to drive traditional production costs higher and further emphasizes the need for alternative systems.[2]

An alternative to conventional rose production methods is to adapt rose production to plant production systems that utilize manufacturing systems engineering (Anderson, 1989; van Weel, 1991; De Vries, 1993; Bredmose and Hansen, 1996). These systems use an "assembly-line" approach because the plants are grown on individual pallets that move on a conveyor system throughout the greenhouse complex. The plants are transferred between greenhouses that maintain an optimal environment for each specific stage of growth. The individual pallets use ebb-flood sub-irrigation as part of the overall closed (recirculating) irrigation system. Because the plants are singulated into individual containers, robotic plant handling equipment can be used to increase labor efficiency in these facilities. Additionally, rose crop models (Jiao, et.al., 1988; Hopper and Hammer, 1990; Pasian and Lieth, 1989) can be integrated with economic and marketing models so true economic optimization of the whole production system (Chao, 1996) can be used to make wise management decisions.

Over the years, research programs in Israel, Germany, The Netherlands, Denmark, Canada, the U.S.A. have evaluated rose cuttings for cut rose production with variable results. Investigations have shown that roses can be grown in small containers and may be adapted to a "manufacturing" system (de Stigter and Broekhuysen, 1985; Anderson, 1989; De Vries, 1993; Bremose and J. Hansen, 1996; Bremose and J. Hansen, 1996; Anderson, 1996). Commercial quality cut roses can be grown in a single stem system (Bremose and J. Hansen, 1996; Anderson, 1996).

Individual rose stems from cuttings require approximately the same time for development as rose stems on a rose shrub in the greenhouse. Yet, a single stem rose production system from propogated cuttings generates relatively high yields from high crop turnover, as well as a better space utilization and environment for plant growth. Additionally, a rose cuttings production system could react much better to market changes and environmental restrictions than traditional rose production techniques. The ability to move greenhouse space in and out of rose production in response to short term economic conditions, particularly where strong seasonal market patterns are observed, makes such a system worth looking at. The cuttings system presents the greenhouse manager with many more production and marketing options relative to conventional in-ground systems.

This paper evaluates the economic performance of two economically engineered systems that incorporate the production approach on a commercial basis. The first approach is a single stem rose production system used for year around rose production. The second approach uses the cuttings system specifically for Valentine's Day production, but integrated into a standard bedding plant operation common in the U.S.A.

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1 The economic benefit of an environmentally superior production system was not included in this particular cost/benefit analysis. Increasing costs for production under conventional systems, however, will make this alternative greenhouse system even more attractive. Differences in relative profitability, while not explored in this paper, would need to account for these significant costs.

The highlights of the technical detail of the production system and quality distribution of yields are discussed in the next section. Projected economic performance based on this production and approach and data is then developed to provide a framework for evaluating the viability of such a system and its sensitivity to production and market variables.

2. *Experimental Approach and Results Using Rose Cuttings*

The phenology of single stem rose production and the resultant rose stem quality was studied with seven sequential crops of single stem roses. Cuttings were started FEB23 (Julian day 54), FEB27 (58), MAR6 (65), MAR15 (74), MAR23 (82), MAR31 (90), and APR7 (97) in 1995. All cuttings, 1904 in total, were numbered individually, identified by crop date and by the origin node number. The dates of rooting, growth of the axillary bud, visible flower bud, and flower harvest were recorded. Stem length (from the point of origin on the cutting to the top of flower) and node number were recorded for each stem at harvest.

Cuttings consisted of a 4-5 cm stem segment with a leaf and axillary bud, most cuttings had a five-leaflet leaf, but cuttings with three or seven leaflets were also included. The lower 1 cm of the cuttings received a 5 s dip in 1000 ppm IBA/500 ppm NAA rooting hormone (Dip 'N' Grow, Astoria-Pacific, Inc., Clackamas OR) and was placed immediately into Scotts MetroMix 360C (Maryville OH) in pots (FEB23 - 10 cm square, 550 ml volume, T&O Plastics, Inc. Minneapolis MN; FEB27, MAR6 & MAR15 - 7 cm round, 120 ml volume, OS Plastics, Marietta GA; MAR23, MAR31 & APR7 - 7.5 cm square, 290 ml volume, T&O Plastics, Inc.). Pots were spaced pot-to-pot on a bench with intermittent mist for 4 s each 6 m for 24 hr per day. Pots were in contact with a hydronic bottom heat system with water temperature of 27C for the 16-21 days of production stage 1.

The rooting date was determined by handling each cutting to determine that it could not be removed from the growing medium easily. Rooted cuttings were moved to double polyethylene greenhouses with a setpoint of 20C day/ 14C night (FEB23, FEB27, MAR6) or 23C day/ 17C night (MAR15, MAR23, MAR31, APR7) for production stage 1. Plants were spaced pot-to-pot and subirrigated on ebb-flood (FEB23, MAR23, MAR31, APR7) or capillary mat benches (FEB27, MAR6, MAR15) with 150 ppm 15-5-15-5Ca-2Mg fertilizer (Scotts Excel, Maryville OH). Plants received 12 hr of supplemental light (1800-600HR) at 80-100 μmoles m^{-2} sec^{-1} until the flower buds were pea-sized.

For production stage 2, the small rose plants with pea-sized buds, 30-35 cm tall, were moved to additional benches in the same greenhouse where the plants received ambient light only. Irrigation and fertilizer practices were continued until flower opening and harvest.

Single stem rose production practices were evaluated during the spring of 1995 with seven sequential crops of roses. The rooting percentages increased, the amount of flower abortion decreased and the percent of stems harvested in flower increased during the spring as production techniques were refined and improved. Single stem production required a mean time of approximately 55 days. The time for rooting and the time from visible bud to flowering were nearly equal at an overall mean of approximately 16 days. The stage from rooting to the appearance of the flower buds required a mean of approximately 23 days. The time for rooting was much less variable than the other stages of production. There was a relatively large variation (six to eight days) for the cuttings to initiate growth of the axillary bud, for the cuttings to have a visible flower bud and for flowering to occur. This variation led to flower harvest over an approximately 30 day period for each crop. Cut rose harvest overlapped significantly in the production cycle of the seven weekly rose crops. The period for flower harvest decreased as the spring progressed.

3. Economic Analysis

3.1 Continuous Roses

Commercial applications of the aforementioned production process require an economic evaluation to determine the feasibility of such a venture. Enterprise budgets were prepared for a commercial production system that would utilize a fraction of the cuttings as on-going replacement stock with the intention of producing roses for the U.S. market year around. Economic returns were estimated using standard methods and measures for evaluating cash flows of agricultural enterprises (Robison and Barry, 1996; Boehlje and Eidman, 1986).

Capital costs were estimated for a 1 hectare greenhouse principally based on figures proposed by Pertwee (1995), but with modifications allowing for less assimilation lighting. Initial capital costs, including the pallet and bench system, were estimated to run between $1.7 and $2 million. Fixed costs were depreciated over 10 years, however the enterprise was evaluated as a seven year investment with positive salvage value, given the useful economic life of a rose plant under conventional production systems is about 7 years. Cash flow analysis assumed 50% of capital costs were up front.

Variable operating costs were similarly estimated, including adjustments for greater labor and management intensity, higher heating, and lower lighting. Production was assumed to initiate with outsourced cuttings with subsequent cuttings taken from the middle grades of marketable stock grown within the greenhouse. Annual operating costs were estimated at $660,000. A detailed enterprise budget was constructed to evaluate cash flows and sensitivity to assumptions relating to market conditions, yield, and required rates of return. A baseline budget is presented with discussion in Appendix A.

Gross revenue was estimated as a function of the grade distribution observed in the experimental conditions reported above and the prevailing price distribution for each grade based on current U.S. industry estimates. An annualized budget is presented in Table 1.

The internal rate of return (IRR) for this investment was estimated under a range of yield and market price scenarios. In this case, market prices represent the season-average price for the top grade red roses, and assumes prices for lower grades are distributed according to the estimated percent of the top grade as observed in recent markets (USDA/NASS, 1997). The 1996 average grower price for hybrid tea roses in the U.S. was reported at $0.347. The net present value of this investment, assuming a 10% discount rate, prevailing market prices, and a yield of 700 stems per sq meter, is estimated to be $2.9 million. Break-even prices ranged from $0.194/stem with yields of 800 stems per sq meter to $0.254/stem with yields of 500 stems. The IRR and break-even estimates are summarized in Table 1.

Table 1. Selected Economic Measures of Profitability, Continuous Roses

Market Price to the Grower	500	600	700	800
	Annual Rose Yield (stems per square meter)			
	Internal rate of return (%)			
$0.24	4	16	27	39
$0.28	20	36	52	68
$0.32	37	57	77	100
$0.36	55	79	106	135
	cents per stem			
Break-even price	25.4	22.7	20.8	19.4

3.2 Valentine Roses Integrated With Other Greenhouse Products

Roses, as indicated earlier, face very cyclical markets in the United States. Stem wholesale prices may average around 30-35 cents annually, but routinely range from $1.10-1.20 around Valentines Day (February 14) to $0.10-0.25 over extended periods for the top grade roses. Rose producers that harvest from in-ground plants can get 6 to 7 crops per year, but rely principally on the strong markets in February to generate the significant amount of their revenue. Relatively weak markets during the majority of the year, together with opportunity costs associated with greenhouse space tied up, make a flexible system that utilizes cuttings to propagate production rather than in-ground plants one way to take advantage to the strong Valentines Day market while shifting to other more profitable greenhouse enterprises during the balance of the year.

Enterprise budgets for an integrated system that featured roses for Valentines Day together with other seasonal products was constructed to examine the potential benefits that could be captured with the additional flexibility. Similar capital costs were employed. Relative operating costs were used for roses, but only for a single inventory turn. Fewer cutting were taken from the propagated stock, since a considerably longer period between intensive rose production activity allowed for cuttings to be produced from cuttings.

General and conservative gross margin estimates of 30% were used for bedding plants, geraniums, hanging baskets, chrysanthemums, and poinsettias, despite industry sources indicating higher percentages to be attainable. Current market prices (USDA/NASS, 1997) and yield estimates from local industry sources were used for the non-rose enterprises. Annual variable costs were loosely estimated for the whole system, but included an important caveat. Each year, 75% of the operating costs were assumed, for the purposes of this analysis, to fall within the first six months to account for the labor and other intensive inputs associated with the roses. Cash flows were then estimated and evaluated on a per six months basis.

Sensitivity analysis was conducted by looking at the range of IRR over recent Valentines Day prices for roses and experimental greenhouse yields. Chicago terminal market prices for top grade roses, as indicated in Table 3, have ranged between $1.10 and $2.25 per stem during the week before Valentines Day since 1990, averaging about $1.70 over that period (AMS, 1997). Actual grower prices would be somewhat less after accounting for transportation and shrinkage costs. Annual returns, however, are estimated to be considerably higher than those estimated utilizing the greenhouse space solely roses.

Internal rates of return were estimated for a range of Valentines Day prices to the grower over a range of yield assumptions. Returns and costs for the other greenhouse enterprises were incorporated into the net IRR. These are presented in Table 2.

Table 2. Economic Measures of Profitability, Roses Integrated With Other Enterprises

Valentines Day Market Price to the Grower	Annual Rose Yield (stems per square meter)			
	500	600	700	800
	Internal rate of return (%)			
$0.90	101	119	139	159
$1.00	112	133	156	181
$1.10	124	148	175	204
$1.20	135	164	195	228

The net present value of this investment, assuming a 10% discount rate, prevailing market prices for the other enterprises (USDA/NASS, 1997) together with Valentine roses, and a yield of 700 stems per sq meter, is estimated to be about $5 million.

The estimated internal rates of return for a single stem rose production system compare favorably to the current market. This system offers the opportunity for returns equal to or much greater than returns that occur in many agricultural or non-agricultural enterprises whether year around rose production is planned or whether single stem roses are integrated into an existing greenhouse enterprise. Seasonal roses, even over conservative yield and market ranges, indicate substantial improvements in the overall profitability of a conventional greenhouse system with 30% margins.

Integrating roses into the overall enterprise mix with this propogation system would appear to provide the best means for taking advantage of seasonal rose markets.

Conclusions

A single stem rose system used for year around production can produce cut roses that will compete with imported roses. A break-even price of $0.21-$0.25 compares well with the average U.S. grower price of $0.347 for cut roses (USDA/NASS, 1997). The system can offer other advantages as well. Cultivars can be changed relatively quickly so a year around operation could produce red roses predominantly for Christmas and Valentine’s Day and switch to white and pastel shades for May and wedding sales during June. Production could be reduced dramatically during the low price summer months to reduce costs. Additionally, the use of ebb-flood benches and recirculating fertigation greatly reduce the potential for waste water runoff from the greenhouse.

Rose prices vary considerably during the year in the U.S.. Although wholesale prices average $0.30-$0.35 per stem for the year, prices range from $1.10-$1.30 in February and drop to $0.10-$0.25 over extended periods of the summer (USDA/NASS, 1997.). A single stem rose production system can be used to take advantage of the high prices in February and the relatively good prices of other crops the remainder of the year. Annual returns were estimated to be considerably higher for a greenhouse that integrated roses with other crops than those estimated for a greenhouse utilized solely for roses.

High capital costs and production uncertainties associated with this propogation system may continue as barriers to wide-scale adoption of these production techniques. The evaluation of potential cash flows, independent of any environmental benefits, strongly suggest such a system to be economically viable.

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APPENDIX A

BASELINE BUDGET FOR CONTINUOUS ROSES

Discussion

Revenue

Total revenue for a continuous rose system utilizing the system and production technology described, would be generated through the sale of roses distributed over essentially five grade classes, including those less than 36 cm which would be unsaleable. The distribution of production across grades is here based on the experimental findings indicated by Anderson here and elsewhere (Anderson, 1996). Grower prices for each grade are based on current USDA-AMS estimates, recent terminal market average differences, and industry estimates gathered independently by the authors.

Total revenue represents the potential revenue from the sale of all marketable product. An adjustment to this "potential sales" is made to reflect the product withheld from the market that provides the material resource for future cuttings for on-going propogations. The decision to sell all product and outsource for needed on-going cuttings or internalize this activity would, of course, be dependant upon the opportunity cost of the middle grade roses. Cuttings, for this analysis, are assumed to be taken in equal proportion from the middle two gardes.

Operating Costs

Pertwee (1995) provides an excellent summary of variable input costs that can be anticipated for a 1 hectare greenhouse. Estimates are projected, however, based on Dutch figures. Some modifications are made here to accommodate different production systems and conditions. Labor makes up about half of the total variable cost. Skilled labor was charged $10/hr to account for the higher skill demanded in the rose propogation, harvesting, and shipping activities. The labor requirement is, following Pertwee, tied directly to total yield.

Heating is estimated to reflect conditions in the mid-south U.S., while variable costs associated with lighting reflect the lesser demands (about 1/4) of this production system. Pesticides and fertilizer bills are estimated to approximate those observed in Holland. Royalties and marketing costs are estimated at market rates, but may vary widely between firms.

Initial rose cuttings are charged as initial cash outlays and assumed to be outsourced from an existing market. It is estimated that about 15% of the marketable stock would be used on average to continuously propogate rose production. Actual total operating costs are inclined to vary widely between commercial greenhouse operations. These estimates are made as a baseline and are no guarantee of continuing input market conditions.

Fixed Costs

Pertwee, again, provides a basis for long-term capital requirements for greenhouse rose production. Evaporative cooling and a system of pallets and benches were added to this system to reflect the fixed capital requirements of this cuttings system. The pallets and benches system, not typically used in an in-ground production approach, represents a significant additional cost, about 1/3 of the total. High and low estimates for the additional equipment are based on current installation costs typical for the U.S. The greenhouse and equipment is assumed for this analysis to have a 10 year useful economic life, depreciated under a straight line method, and over 7 years (for ease of comparison to a typical in-ground production system). A salvage value is estimated based on the balance of the assets expected economic life. The cost of the system is estimated to be between $1.7 and $2.1 million. An average is used for the purpose of assigning a fixed cost.

Interest on the fixed assets, together with real estate taxes and insurance, were roughly estimated following the conventions suggested by Boelje & Eidman (p. 159-160, 1984)[3]. Actual costs may vary somewhat, depending on location and sources of capital. An important caveat is that financing for a riskier, unproven technology for production into an increasingly cost competitive market may be more difficult to obtain relative to more proven enterprises. This can be handled in an economic analysis in a number of ways. In this case, risk exposure for the financier is reduced through a 50% beginning equity position required by the investor. A 10% mortgage is then paid off in 7 years, with cash flows estimated for payments every 6 months. Higher interest and insurance rates may still be required under such arrangements.

Cash flows

Cash flows are estimated from the enterprise budget and estimated setup cash expenses. It is assumed that the land is already available and that a 50% equity position is required to begin operations. Cash flows are divided between an operating portion and a fixed portion. The fixed portion represents the principal and interest on the mortgage payment plus the real estate taxes and insurance.

Operating cash flows are also estimated on a 6 month basis, with the cost of outsourcing the rose cuttings initially being included as an extra cash expense occurred within the first six months. Operating cash flow is not anticipated to flow evenly over the year. Inflows are expected to be substantially higher over the Valentines Day market, subsequently 75% of annual revenue is estimated to be realized during the first half of the year. Variable cash operating expenses are also anticipated to be substantially higher during the first half of the year (75% of variable operating costs for this analysis), due to higher heating, lighting, marketing, and therefore interest on operating expenses during the winter months. The 75/25 split is only a rough estimate, but if erring, errs on the side of understating early revenues and overstating early expenses.

These cash flows are used as the basis for evaluating net present value and the internal rate of return under as variety of market and yield assumptions. Cash flows for the baseline case of a yield of 700 stems/sq meter and an average of $0.34 for the top grade rose is presented at the end of the enterprise budget in this appendix.

[3] Real estate taxes and insurance costs per year can be roughly approximated by dividing the construction costs and the salvage value by 2 and multiplying by the appropriate rate. A 1% rate was used for the baseline.

BASELINE BUDGET FOR ROSES INTEGRATED WITH OTHER GREENHOUSE ENTERPRISES

Discussion

Revenue

Total revenue for an integrated greenhouse system is estimated based on a scheduled rotation that includes roses, bedding plants, geraniums, hanging baskets, chrysanthemums, and poinsettias. All products are assumed to utilize the same pallet and bench greenhouse propogation system. Roses are assumed to start in December, utilizing 95% of the space and targeted for harvest just prior to Valentines Day. Roses could potentially be turned between 6 and 8 times over a year. Yield assumptions are based here on 1/6 of the annual production potential, with the quality distribution consistent with that observed experimentally. Seasonal rose revenue still makes up over 40% of the annual greenhouse revenue, even though it is only occupying space for two months.

Production, space, and price assumptions for each enterprise are summarized in Table 3 below. Yields for the other greenhouse enterprises are based on current industry estimates in Kentucky. Prices reflect grower prices as reported in the 1997 Floriculture Crops (USDA, 1997).

Table 3. Integrated Greenhouse Enterprise Data

Enterprise	Dates	Yield	Greenhouse Space	Total Production	Price per unit	Total Revenue
Roses	12/1-2/14	700 stems/m^2	100%	1,166,667 stems	$1.10[7]	$920,061
Bedding Plants[4]	3/1-6/15	6 flats/m^2	80%	83,904 flats	$7.00	$587,328
Geraniums[5]	3/1-6/15	53.8 pots/m^2	20%	148,488 pots	$1.25	$185,610
Hanging baskets	3/1-6/15	4.3 baskets/m^2	40%[6]	15,824 baskets	$5.50	$87,032
Chrysanthemums	8/15-9/15	7.2 pots/m^2	95%	62,928 pots	$1.80	$113,270
Poinsettias	8/15-12/1	7.7 pots/m^2	80%	56,672 pots	$4.15	$235,189
Total Greenhouse Revenue						$2,128,490

Operating Costs

Operating costs are estimated separately for roses. Labor costs are estimated as a function of rose yield, following Pertwee. Other variable costs for roses are estimated only for production of the one inventory turn.

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4 Period allows for 1.9 turns for bedding plants. Yield is on a per turn basis.

5 Period allows for 1.5 turns for geraniums. Yield is on a per turn basis.

6 Greenhouse space is allowed to exceed 100% capacity due to the unique space utilization of the hanging plants.

7 Price for top grade. Smaller roses with quality yields distributed as before would be discounted.

Producer margins for basic greenhouse products such as those included in this analysis vary between enterprises, particularly as they differ in size and market emphasis. The minimum margin indicated by growers in the Kentucky area for any of the supplemental enterprises considered here was 30%. This 30% margin was used as a conservative benchmark for the non-rose enterprises to compare the relative attractiveness of having flexibility in the production of roses. Operating costs plus 5/6 of the fixed costs were therefore estimated to be 70% of the non-rose revenue.[8]

Initial cuttings are again outsourced. A smaller fraction of cuttings are required to be taken from marketable production (5% versus 15% previously) since propogations can be taken from several generations of plants between February and December.

Fixed Costs

Essentially the same capital inputs are assumed to be required for the wider scope of enterprises plus seasonal roses as would be for year around rose production. Annualized fixed costs were calculated, therefore, in a similar fashion.

Cash Flows

Similar assumptions are made for the integrated operation in terms of up front capital requirements. It can be argued, however, that one turn of roses integrated with other proven enterprises is less risky, and therefore may require less initial owners equity. Equity requirements are left equal here, considering that cut roses still make up a significant portion of the operation.

As before, 75% of annual operating costs are assumed to fall within the first half of the year, reflecting proportional costs associated with the roses. Cash inflows follow the schedule of the respective enterprises as indicated above.

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[8] There are a variety of ways the fixed costs can be assigned to the non-rose enterprises. Since the fixed assets are tied up by rose production for about 1/6 of the year, 5/6 of total fixed costs was employed here to be charged to the other activities.