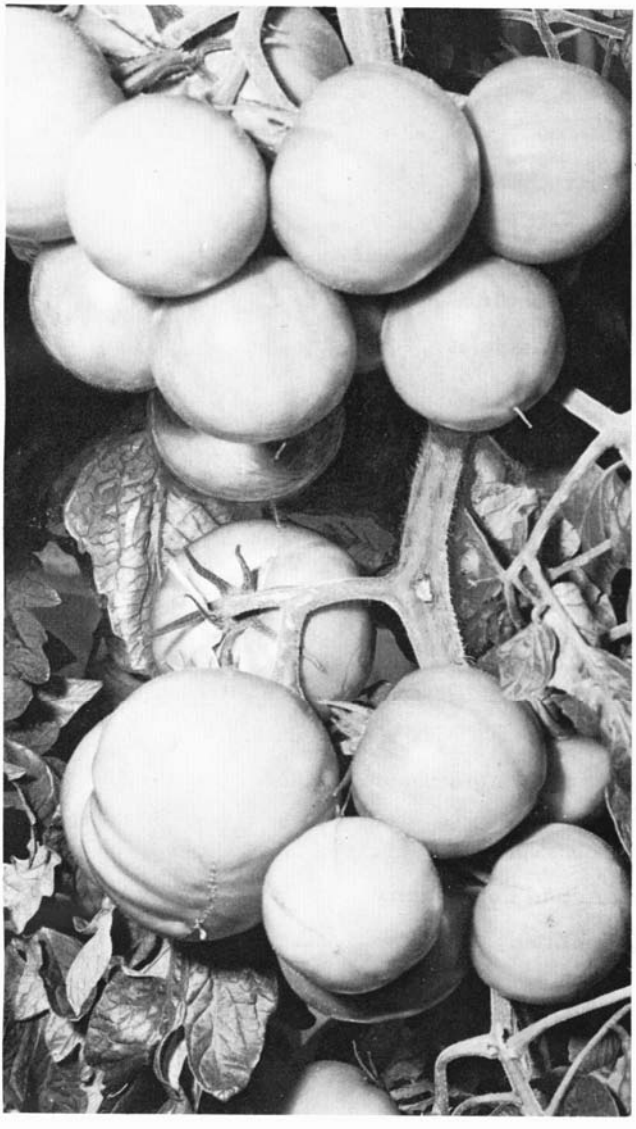
UNIVERSITY OF ILLINOIS · COLLEGE OF AGRICULTURE · COOPERATIVE EXTENSION SERVICE CIRCULAR 914



THE FEASIBILITY OF GROWING GREENHOUSE TOMATOES IN SOUTHERN ILLINOIS

COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF ILLINOIS

AREA REDEVELOPMENT ADMINISTRATION
TECHNICAL ASSISTANCE PROJECT
U. S. DEPARTMENT OF COMMERCE

CONTENTS

Cooperative Extension Work in Agriculture and Home Economics: University of Illinois, College of Agriculture, and the United States Department of Agriculture cooperating. John B. Claar, *Director*. Acts approved by Congress May and June 30, 1914.

Urbana, Illinois August, 1965

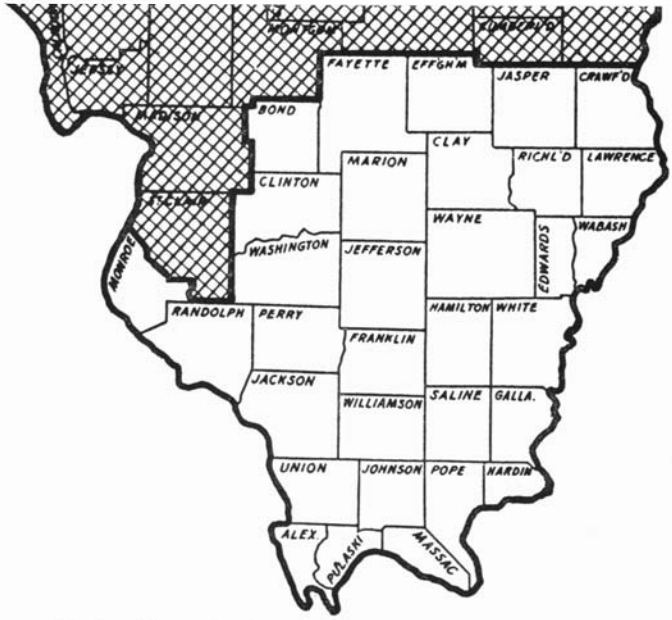
This circular was prepared by J. W. Courter, Assistant Professor of Horticulture; J. S. Vandemark, Professor of Horticulture; and R. A. Hinton, Assistant Professor of Farm Management. The work was supported in part by a grant from the U.S. Department of Commerce, Area Redevelopment Administration.

The following persons have contributed to this study: L. B. Broom, H. A. Cate, L. P. Fettig, W. F. Lomasney, E. C. Mosser, and E. L. Sauer, University of Illinois; W. L. Denmark, State Water Survey; and W. A. Kelton, Florists Mutual Insurance Co., Edwardsville, Ill.

THE SOUTHERN 32 counties of Illinois include about 25 percent of the state's geographic area (Fig. 1) but only about 10 percent of the population. The economy of the region depends mainly on manufacturing and general farming supported by mining, retailing, and construction. Technological advances in agriculture have reduced the labor requirements of farms, resulting in part-time farm employment for a significant proportion of farm operators. Automation in mining has further reduced employment in the area.

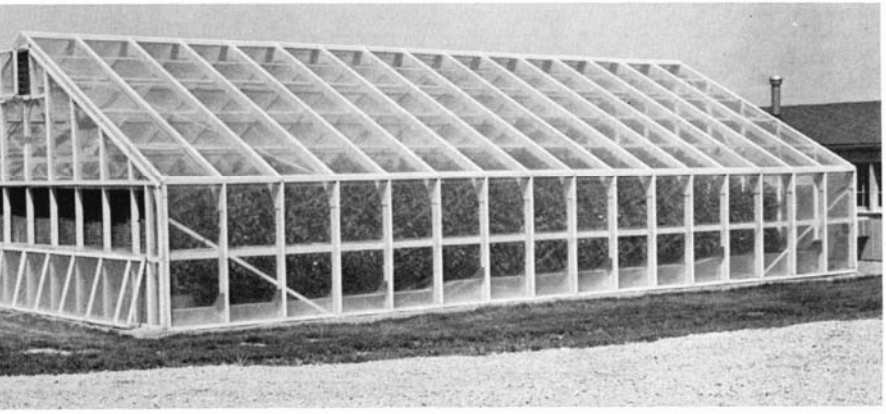
If farming is to continue as a major economic activity for a farm operator and his family, the operator must increase the size of his farm business in order to fully utilize available labor. Size of business may be increased extensively by adding more acres, or intensively by raising crops or livestock which require more labor and capital in relation to land.

Growing vegetables in either glass or plastic greenhouses affords one opportunity for intensive production, requiring high labor input



The 32 counties in this study (unshaded area). Madison and St. Clair Counties, lying west of the 32-county area, were not included because they are part of the metropolitan St. Louis area and their economy differs from that of the rest of southern Illinois. Much of the information in this circular applies to these two counties, however, and some of it may apply to counties farther north. (Fig. 1)

This large range of glass greenhouses is used for growing tomatoes. A headhouse with boiler room, storage, and work area connects the ends of the greenhouses. (Fig. 2)



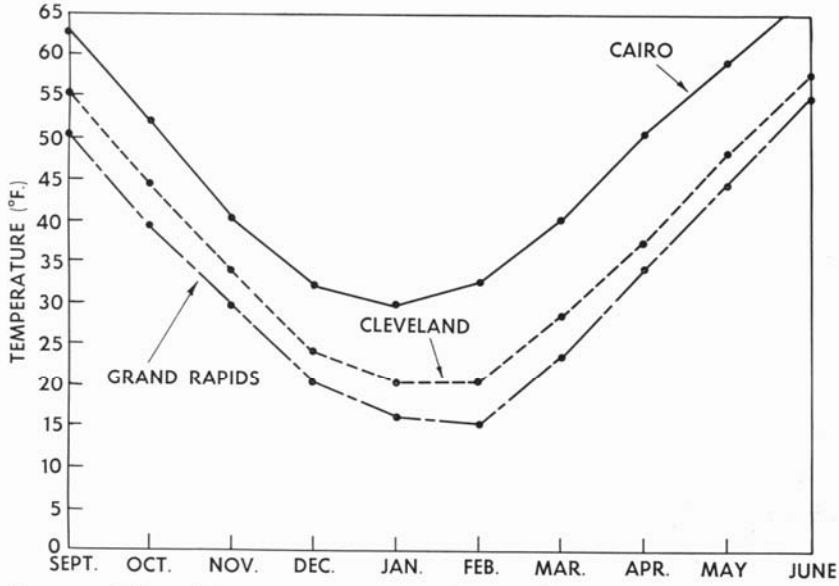
A small plastic-covered greenhouse is suitable for limited production. Plastic greenhouses cost less than glass structures, but they depreciate over a shorter period. (Fig. 3)

but only nominal land utilization. About three full-time men per acre are needed for greenhouse production. In comparison, 150 to 300 acres are necessary to keep one man fully employed in general farming in this area. The potential for high economic return can justify the substantial capital investment required for greenhouse facilities.

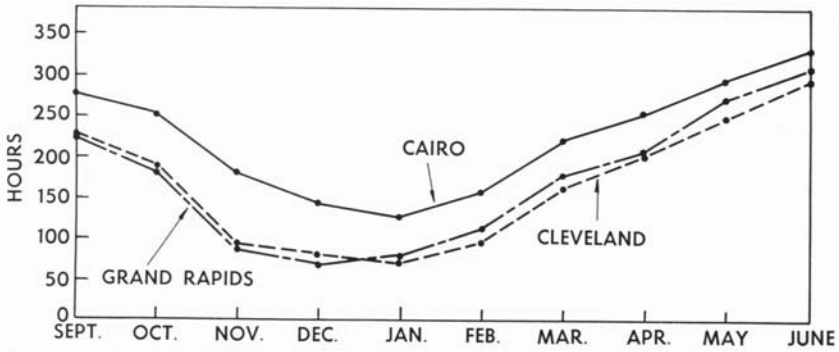
This study emphasizes greenhouse production of tomatoes. Other vegetable crops are briefly mentioned where they may be involved in production schedules.

FAVORABLE CLIMATE

The northern part of the 32-county region is approximately 100 miles south of Indianapolis, Indiana; 300 miles south of Cleveland, Ohio; and 400 miles south of Grand Rapids, Michigan, important greenhouse vegetable-producing centers. In the 32-county region, the average daily minimum temperatures in winter are 5 to 15 degrees higher



Average daily minimum temperatures, by month. (Fig. 4)



Average hours of full sunlight, by month. (Fig. 5)

than in Cleveland or Grand Rapids (12)* (Fig. 4). In addition, coal is less expensive in southern Illinois. For these two reasons the cost of heating, one of the biggest expenses in greenhouse production, is 40 to 50 percent lower in southern Illinois than in the greenhouse areas farther north.

Clear, bright winter days give southern Illinois a further advantage over the northern greenhouse areas, where insufficient sunlight limits greenhouse production from December through February. During this period Cairo, Illinois, has 60 to 70 percent more hours of sunlight than Cleveland (12) (Fig. 5). In January, when cloud cover is at a maximum, southern Illinois averages 130 hours of full sunlight which is more than Cleveland or Grand Rapids receives, on the average, in any 30-day period from mid-October to mid-February. Other factors being equal, growers in southern Illinois should be able to start a spring tomato crop 6 weeks earlier than growers in northern greenhouse regions.

PRODUCTION SCHEDULES

Tomatoes can be grown in greenhouses for marketing at any time during the year. However, greenhouse producers cannot compete with local outdoor crops in July, August, and September; and growing tomatoes for market in January, February, and March involves critical management problems. Therefore, a two-crop schedule has developed historically in an effort to strike a balance among several considerations — production costs, yield potentials, competition, and prices.

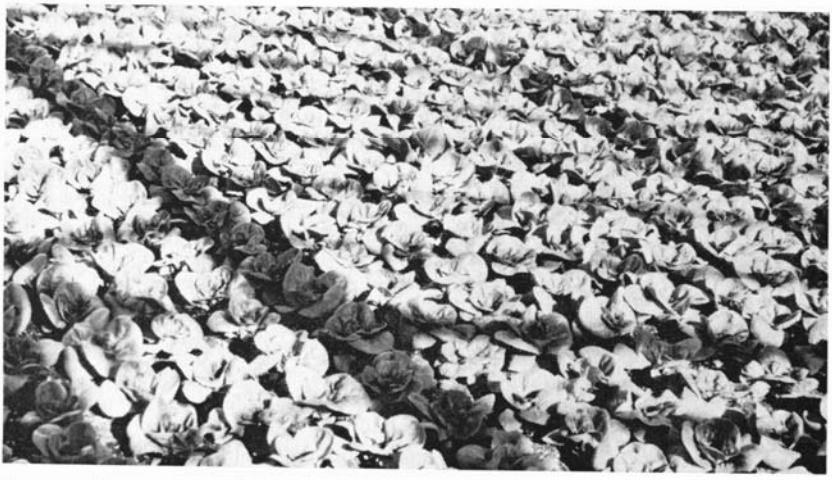
Seed is planted in mid-summer for the fall tomato crop, which is harvested from mid-October through December (Table 1). Seed is

* Figures in parentheses refer to the references cited on page 23.

Table 1. — Planting Schedules for Greenhouse Tomatoes

Crop	Sow seed	Plants bedded in greenhouse	Harvest period
Two-crop schedule[a]			
Fall	June 15-July 15	Aug. 1-Sept. 1	Oct. 15-Jan. 1
Spring	Nov. 1-Nov. 15	Jan. 5-Jan. 15	March 20-July 15
Single-crop schedule			
Mid-winter	Sept. 15-Oct. 15	Nov. 1-Dec. 10	Feb. 15-July 15

[a] Growers sometimes grow chrysanthemums or two or three crops of lettuce instead of fall tomatoes in the two-crop schedule.



Two or three crops of lettuce may be substituted for the fall tomato crop. Depending on the market, either leaf lettuce (top picture) or Bibb lettuce may be grown. (Fig. 6)

planted in November for the spring tomato crop, which is harvested from mid-March through early July, when early outdoor crops become available (Table 1).

The spring tomato crop is far more important economically than the fall crop because of the longer harvest period, higher production, and generally higher prices. Growers may produce two or three crops of lettuce or one crop of chrysanthemums during the fall and mid-winter months in lieu of a fall tomato crop.

Because of the favorable distribution of winter sunlight, production of a single mid-winter crop of tomatoes, rather than the conventional two-crop schedule, may be feasible in southern Illinois. This crop would be planted in the greenhouse in early fall for marketing from February to July (Table 1). One tomato crop a year, with or without rotation of other crops, has special merit as it eliminates the transfer of diseases from low-value fall tomatoes to higher value spring tomatoes.

Despite the advantages of a one-crop system, only growers with highly developed skills in greenhouse production should attempt to grow a single mid-winter tomato crop.

MANAGEMENT

Successful growing of greenhouse tomatoes is complex and difficult. Skillful management and application of modern horticultural technology are necessary to achieve high levels of production. The returns from a commercial greenhouse tomato business may vary widely according to the operator's management ability.

Essentially all environmental factors in the greenhouse except sunlight can be modified and partially controlled. The grower must know how to regulate the daily schedule to compensate for climatic changes. This involves a working knowledge of the influence of temperature, light, humidity, soil moisture, air composition, and soil fertility on flowering, fruiting, and plant growth. These interacting factors must be skillfully manipulated according to the prevailing and constantly changing light conditions. Management of environmental conditions is also critical for controlling certain plant diseases.

Farmers without adequate horticultural background should carefully study the technology involved in greenhouse production before entering this highly specialized business.[1]

CAPITAL REQUIREMENTS

Although land requirements are nominal, a substantial capital investment is needed for greenhouse facilities. Glass greenhouses of ¼ to ½ acre in size cost $2.00 to $2.50 per square foot. Construction costs per square foot increase as size of structure decreases below about 10,000 square feet. There is, however, little decrease in unit cost for structures above this size.

[1] For information on culture of greenhouse vegetable crops, write to the Department of Horticulture, University of Illinois, Urbana, Illinois.

TWO IMPORTANT MANAGEMENT PRACTICES

Tomato plants are pruned and trained to a single stem (left). About 10 clusters are harvested on each plant. Careful management and pollination are essential for maximum fruit production from each cluster. A good crop is set on this plant. (Fig. 7)

As shown below, tomato flowers are mechanically vibrated to insure adequate pollination in the greenhouse. (Fig. 8)

Table 2. — Investment Capital Required for Heated and Ventilated Greenhouse Facilities

Type of structure	Capital investment	
	Cost per sq. ft.[a]	Total cost per acre
Glass	$ 2.00-2.50	$ 90,000-120,000
Semipermanent plastic (as Mylar)[b]	.75-1.00	35,000- 45,000
Temporary plastic (as polyethylene)[b]	.50- .70	22,000- 33,000

[a] Glass greenhouse structures increase substantially in cost per square foot for units smaller than 10,000 to 20,000 square feet.
[b] Labor not included. Hired labor increases the cost by 10 to 30 cents per square foot, depending on local wage scale.

Sometimes the only way a grower can enter greenhouse production is to substitute low-cost plastic construction for glass.[1] This way, he can build larger facilities with a limited capital investment. Plastic rather than glass greenhouses may be favored because of availability of labor and building materials, as well as limitation of investment capital.

In Table 2 the capital requirements for plastic construction are compared with those for glass construction. These figures include costs for the complete structure with heating and ventilating systems. Benches are not included as vegetables are successfully grown in ground bed culture. Figures for glass include labor for construction. Those for plastic, however, do not include labor because often plastic greenhouses can be built entirely or partly by the grower himself. Hired labor for construction of plastic greenhouses would add $6,000 to $10,000 per acre, depending on complexity of construction and local wage scale.

An all-weather road, clean water source, utilities, and service building must also be considered as part of the initial capital investment. Costs for these facilities are not included in this study because they are available on many farms.

PRODUCTION COSTS

Production costs were calculated for establishing and raising two greenhouse tomato crops a year. Data for the calculations were derived from experiences in previous experimental work (1, 2, 3) and from estimates given by greenhouse operators in the area.

[1] For information on construction of plastic greenhouses, see Illinois Extension Circular 905, "Plastic Greenhouses," which may be obtained by writing to the Agricultural Information Office, 112 Mumford Hall, Urbana, Ill.

Ownership costs

Annual fixed costs, given in Table 3, include only the costs associated with ownership and maintenance of the greenhouse: depreciation, taxes, interest on investment, insurance, and repairs of greenhouse facility. Land costs are not included.

The capital investment for glass greenhouse facilities is depreciated in a 20-year period, rather than the serviceable life, which may be 50 to 60 years or longer. Growers would be reluctant to invest in such a facility unless the investment could be amortized within a reasonable period of time. Generally, glass greenhouses have a significant resale value, even after 20 or 30 years of usage, providing the structure is in good condition.

Semipermanent plastic construction, such as Mylar, is depreciated in a 10-year period, and more temporary plastic construction, such as polyethylene, is depreciated in a 5-year period. The salvage value of plastic greenhouse structures will probably be insignificant after these depreciation periods. However, if forethought is given to initial construction of wooden frameworks, and if the structures are carefully maintained, plastic greenhouses should have a serviceable life of 15 to 20 years.

Table 3. — Approximate Annual Fixed Costs per Acre for Glass and Plastic Greenhouses

Cost item	Approximate cost per acre		
	Glass (investment $90,000-120,000)	Semipermanent plastic (investment $35,000-45,000)	Temporary plastic (investment $22,000-33,000)
Interest[a]	$ 2,475- 3,300	$ 975- 1,250	$ 600- 900
Taxes[b]	450- 550	100- 200	.....
Insurance[c]	450- 700	750- 900	150- 250
Maintenance[d]	300- 600	2,000- 2,200	850- 900
Depreciation[e]	4,500- 6,000	3,500- 4,500	4,400- 6,600
Total annual fixed cost	$ 8,175- 11,150	$ 7,325- 9,050	$ 6,000- 8,650

[a] Calculated at 5.5 percent of mid-point valuation.

[b] Taxes may be considerably higher in urban areas.

[c] Coverage includes fire, wind, and hail for all types of construction, and snow for glass construction. The cost range for glass construction depends on age and condition of the greenhouse. Coverage for Mylar-covered greenhouse includes both structure and plastic; for polyethylene-covered greenhouse, only the structure. Insurance coverage on service buildings, boiler, and crop is not included. Crop insurance for vegetables grown in glass greenhouses costs about $250 to $300 per acre per year; it is not available for vegetables grown in plastic greenhouses.

[d] Material costs only. Mylar houses must be recovered every 4 or 5 years; polyethylene, every year. Hired labor would add an estimated $750 to $1500 per year to the above maintenance costs for plastic greenhouses.

[e] Depreciation: glass in 20 years, Mylar in 10 years, polyethylene in 5 years. If labor for original construction of plastic greenhouses must be hired, depreciation costs for these structures would be increased by $500 to $2,000 per year.

Maintenance costs for plastic greenhouses are much higher than for glass greenhouses because the plastic covering must be replaced frequently. Polyethylene covering film must be replaced annually and Mylar film must be replaced each four or five years. If labor has to be hired, maintenance costs for plastic greenhouses will be $750 to $1,500 higher than shown in Table 3.

Operating costs

Annual operating costs in this analysis include only the cash costs incurred in producing two crops of tomatoes. Marketing expenses are discussed under "Returns" as deductions from the gross income. These costs may be as much as $8,000 to $10,000 per acre per year.

The most important operating costs are labor and fuel (Table 4). Hired labor may easily account for about one-half of the total operating costs. In Table 4 labor costs have been calculated on the basis of one full-time hired man per acre plus two part-time workers during the peak harvest loads, or the equivalent of two full-time employees per acre per year.

The value of the manager-operator's labor is not included in budgeting labor costs. Wages of the manager-operator are included in the net returns to family labor and management (pages 13-18). Additional returns may be realized if other members of the family can be employed as part of the labor requirements. In calculating costs and returns for various sized greenhouse units, it is assumed that family labor alone is sufficient to operate units smaller than 20,000 square feet.

Because of the high labor input and lack of opportunity to mechanize many operations, the cost of production per unit does not vary

Table 4. — Approximate Annual Operating Costs to Produce Two Tomato Crops per Acre

Item	Approximate cost
Seed (2 oz. per crop)	$ 25- 120
Mulch (200 bales of straw per crop)	150- 200
Fertilizer and soil tests	400- 500
Manure	200- 250
Disease and insect control	150- 250
Electricity	400- 600
Telephone	100- 150
Miscellaneous (pot replacements, bands, shading, twine, gas, oil)	300- 500
Fuel (coal @ $5.50-$7.00 per ton)	2,500- 3,500
Labor (equivalent 2 full-time men)[a]	4,800- 6,720
Total	$9,025-12,790

[a] The manager-operator's wages are shown as returns to management in later calculations.

appreciably with the size of operation. It does, however, vary widely with efficiency and yield. The manager-operator of a small greenhouse who works closely with one or two skilled employees often has better control than the manager of a larger greenhouse who must spend his time supervising several less skilled employees. Unit costs may go up even though the employees are paid at a lower wage scale. Therefore, technically well-organized and properly managed family units can compete with larger greenhouse units.

RETURNS

Both experimental results (2) and experiences of commercial growers have shown that equally good yields can be produced in either glass or plastic greenhouses. Because of different environmental conditions, however, plastic greenhouses require somewhat different management and compensation in installation of heating and ventilating systems.

Variety, plant population, spacing, and yields per plant greatly influence production. Plants are normally spaced to allow 4 to 5 square feet per plant. Production figures given in this circular are based on spacings of 5 square feet per plant or 8,712 plants per acre. Higher plant populations have higher yield potential (Table 5).

Yields per plant may range from 6 to 10 pounds for the fall crop and from 12 to 20 pounds for the spring crop (Table 6). If the above maximum yields were obtained, total production would be about 44 tons per acre for a fall crop and 87 tons per acre for a spring crop. Yields from a single spring crop can be as high as 100 tons per acre with extended harvest periods, increased plant populations, or both. Only the best growers, however, get yields of 20 pounds or more per plant from the spring crop or of 10 pounds from the fall crop.

Table 5. — Influence of Plant Population and Yield on Production of Greenhouse Tomatoes per Acre

Number of plants per acre	Spacing per plant	Yield, lb. per plant				
		8	10	12	14	16
	Sq. ft.	*Number of 8-lb. baskets*				
8,712	5	8,712	10,890	13,068	15,246	17,424
10,890	4	10,890	13,612	16,335	19,057	21,780
14,520	3	14,520	18,150	21,780	25,410	29,140

For this study, a total annual production of 20 pounds per plant (8 pounds in the fall and 12 pounds in the spring) was assumed as the basis for calculating returns. This level of production necessitates good management but it is realistic and practical for a two-crop schedule.

The relationship of yield per plant and size of the greenhouse unit to total production of 8-pound baskets of tomatoes is shown in Table 7.

Table 6. — Yields of Selected Tomato Varieties in Greenhouse Production Tests[a]

Variety	Fruit color	Leaf mold[b]	Marketable yield			Aver. yield[c]
			1962	1963	1964	
Fall crop			*Lb. per plant*			Tons/acre
Michigan-Ohio Hybrid..	Red	S	8.3	10.7	10.5	47.4
Ohio WR-7	Pink	S	8.0	10.3	9.9	45.5
Tuckcross O	Red	R	8.8	9.9	—	45.5
P-115.....	Pink	R	6.7	6.7	8.8	35.8
Spartan Pink-10	Pink	S	5.8	8.5	—	34.9
Spring crop						
P-115.....	Pink	R	—	18.8	20.7	95.8
Michigan-Ohio Hybrid..	Red	S	13.8	16.9	21.5	84.2
Tuckcross-O	Red	R	16.1	16.0	—	77.9
Ohio WR-7	Pink	S	10.4	12.8	20.2	70.2
Spartan Pink-10	Pink	S	12.5	—	—	60.5

[a] Data from tomato variety tests in plastic greenhouses at the Dixon Springs Agricultural Center, Simpson, Illinois.
[b] S — Variety is susceptible to common strain of *Cladosporium fulvum;* R — Variety is resistant.
[c] Plants grown at spacing of 4.5 square feet, or approximately 9,680 plants per acre.

Table 7. — Influence of Yield per Plant and Size of Greenhouse on Total Production of 8-Pound Baskets

Size of greenhouse, square feet	No. of plants[a]	Yield, lbs. per plant					
		6	8	10	12	14	16
		Number of 8-lb. baskets					
2,000.....	400	300	400	500	600	700	800
4,000.....	800	600	800	1,000	1,200	1,400	1,600
6,000.....	1,200	900	1,200	1,500	1,800	2,100	2,400
8,000.....	1,600	1,200	1,600	2,000	2,400	2,800	3,200
10,000.....	2,000	1,500	2,000	2,500	3,000	3,500	4,000
20,000.....	4,000	3,000	4,000	5,000	6,000	7,000	8,000
40,000.....	8,000	6,000	8,000	10,000	12,000	14,000	16,000
43,560.....	8,712	6,534	8,712	10,890	13,068	15,246	17,424

[a] Plant spacing of 5 square feet (8,712 plants per acre).

Primary source of income

The production of two crops of tomatoes per year in a greenhouse ½ to 1 acre in size can provide full-time employment and be the primary source of family income. The gross cash returns less direct marketing costs of baskets, hauling, and selling southern Illinois tomatoes in Chicago are calculated for selected volumes of production and four average price levels (Table 8). Direct marketing costs are:

Table 8. — Gross Cash Returns, Less Direct Marketing Costs, at Four Price Levels for Different Volumes of Production

Production of 8-lb. baskets	Cost of basket and hauling[a]	Average prices of 8-pound basket			
		$1.50 (1.35)[b]	$1.75 (1.57)	$2.00 (1.80)	$2.25 (2.02)
		Total gross cash returns less direct marketing costs[c]			
2,000	$ 600	$ 2,100	$ 2,540	$ 3,000	$ 3,440
4,000	1,200	4,200	5,080	6,000	6,880
6,000	1,800	6,300	7,620	9,000	10,320
8,000	2,400	8,400	10,160	12,000	13,760
10,000	3,000	10,500	12,700	15,000	17,200
12,000	3,600	12,600	15,240	18,000	20,640
14,000	4,200	14,700	17,780	21,000	24,080
16,000	4,800	16,800	20,320	24,000	27,520
18,000	5,400	18,900	22,860	27,000	30,960
20,000	6,000	21,000	25,400	30,000	34,400
22,000	6,600	23,100	27,940	33,000	37,840
24,000	7,200	25,200	30,480	36,000	41,280
26,000	7,800	27,300	33,020	39,000	44,720

[a] Calculated at 30 cents per 8-lb. basket (14 cents for basket, lid and paper and 16 cents for hauling).
[b] Figures in parentheses are grower's returns per basket minus 10 percent commission.
[c] Direct marketing costs are cost of basket, hauling, and commission.

Table 9. — Estimated Net Returns for Labor and Management for Production of 1 Acre of Greenhouse Tomatoes

Item	Glass	Semipermanent plastic	Temporary plastic
Fixed costs	$ 8,175-11,150	$ 7,325- 9,050	$ 6,000- 8,650
Operating costs	9,025-12,790	9,025-12,790	9,025-12,790
Total costs	$17,200-23,940	$16,350-21,840	$15,025-21,440
Gross cash returns less direct marketing costs[a]	$27,940-33,000	$27,940-33,000	$27,940-33,000
Net returns to labor and management	$ 4,000-15,800	$ 6,100-16,650	$ 6,500-17,975

[a] Calculated for a production of 20 pounds per plant, for total production from two crops per year, at an average price of $1.75 to $2.00 per 8-lb. basket.

baskets, lids and paper, 14 cents; hauling, 16 cents; and selling commission, 10 percent of selling price per 8-pound basket.

The probable returns for family labor and management of an acre unit are shown in Table 9. These potential returns are calculated by subtracting the fixed and operating costs (Tables 3 and 4) from the anticipated gross returns (Table 8). It is apparent that somewhat higher net returns are theoretically possible from the lowest cost polyethylene greenhouse unit. Labor costs for original construction and maintenance were not included in the fixed costs for plastic greenhouses, however; so the advantage of this construction would be lost if all labor had to be hired.

Since the plastic greenhouse depreciates over a short time with practically no salvage value, the grower must produce consistently good yields each year without failure. The glass-greenhouse producer, on the other hand, has a considerably longer period over which to average good and poor yields and prices. Furthermore, glass greenhouses have a reasonable salvage value after 20 years of use with good maintenance.

Supplemental income

Greenhouse units less than ½ acre in size can provide employment during the fall, winter, and early spring to supplement family income. Greenhouses smaller than about 4,000 square feet appear not to be feasible because of their low economic potential. The returns to the family for labor and management for three sizes of polyethylene-covered greenhouses are given in Table 10. Wages for hired labor

Table 10. — Estimated Net Returns for Labor and Management for Production of Two Crops of Tomatoes in Small Polyethylene Greenhouse Units Employing Family Labor

Item	Size of greenhouse, square feet		
	5,000	10,000	20,000
Amount of investment	$2,500-3,750	$5,000-7,500	$10,000-15,000
Fixed costs	700-1,000	1,500-2,000	2,700- 3,900
Operating costs[a]	600- 800	1,200-1,500	2,200- 3,000
Total costs	1,300-1,800	2,700-3,500	4,900- 6,900
Gross cash returns less direct marketing costs[b]	3,175-3,750	6,350-7,500	12,700-15,000
Net returns to labor and management	$1,375-2,450	$2,850-4,800	$ 5,800-10,100

[a] No hired labor budgeted.

[b] Calculated for a production of 20 pounds per plant, for total production from two crops per year, at an average price of $1.75 to $2.00 per 8-lb. basket.

are not included in the operating cost since these smaller units would be operated entirely by family labor.

Late spring schedule for supplemental income

Growing one crop of late spring tomatoes in a temporary polyethylene greenhouse appears to be a good way of supplementing family income. Tomatoes would be planted about March 1, so that most of the severe winter weather would be avoided and the crop would develop entirely under the longer and warmer spring days. The crop would be marketed from about mid-April to July 1.

Greenhouse construction may be more temporary than required for year-round production. A minimum investment is needed for heating equipment; and such high-cost fuels as gas can be economically used during the shorter heating period. Manual ventilation can also result in savings over fan ventilation.

Capital investment requirements, fixed and operating costs, and potential returns for units of 10,000, 20,000, and 40,000 square feet are shown in Table 11. These returns are based on a spacing of 5 square feet per plant with an average production of 12 pounds per plant. Greater production and higher returns are possible by increasing the plant population and by extending the marketing period through July. For the longer marketing period, the polyethylene covering could be removed and the tomatoes grown as an outdoor crop. Production would thus blend in with the supply of field tomatoes.

Table 11. — Estimated Net Returns for Labor and Management for Production of One Crop of Late Spring Tomatoes in Polyethylene Greenhouse Units

Item	Size of greenhouse, square feet		
	10,000	20,000	40,000
Amount of investment	$4,250-6,750	$8,500-13,500	$17,000-25,000
Fixed costs	1,150-1,650	2,300- 3,300	4,600- 6,600
Operating costs	500- 800[a]	1,000- 1,600[a]	4,000- 5,650[b]
Total costs	1,650-2,450	3,300- 4,900	8,600-12,250
Gross cash returns less direct marketing costs[c]	3,800-4,500	7,600- 9,000	15,200-18,000
Net returns to labor and management	$1,350-2,850	$2,700- 5,700	$ 2,950- 9,400

[a] No hired labor budgeted.
[b] Includes wages for one full-time hired man.
[c] Calculated for a production of 12 pounds per plant, at an average price of $1.75 to $2.00 per 8-lb. basket.

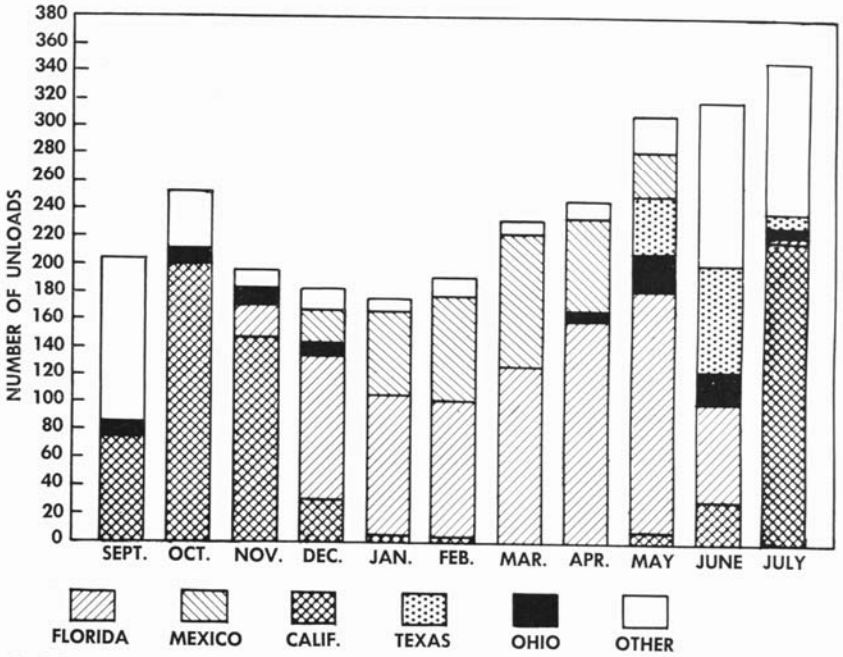
Further income could be obtained from these structures by growing one or two crops of fall and early winter lettuce.

The capital investment required for temporary polyethylene structures is based on building costs of 40 to 60¢ per square foot. In some instances, these costs could be lower.

MARKETING

A continuous supply of fresh tomatoes is available in most markets in the United States (10, 11). This supply is maximum during the late spring and summer, when vine-ripened tomatoes from outdoor field production are available. The rest of the year, the supply consists mostly of green wraps from California, Texas, and Florida; and limited supplies of vine ripes, imports, and greenhouse tomatoes.

In Chicago, where nearly 50,000 tons are sold annually, the market expands steadily from February through July (Fig. 9). The normal spring greenhouse tomato crop matures in April, May, June, and



Origin and number of rail and truck unloads of fresh tomatoes in Chicago, 1960-1963. "Other" includes Illinois, Arkansas, and Michigan, as well as a few other sources. (Fig. 9)

early July, during the period of market expansion. All the tomatoes coming into Chicago from Ohio during April, May, and June (Fig. 9) are greenhouse tomatoes.

The main competition for spring greenhouse tomatoes comes from Florida, Texas, and Mexico. This competition will probably increase in the future. Improvements can be expected both in transportation and in the quality of southern tomatoes as new varieties and better production practices and handling techniques are adopted. Then proximity to market will become less of an advantage for midwestern greenhouse tomato producers.

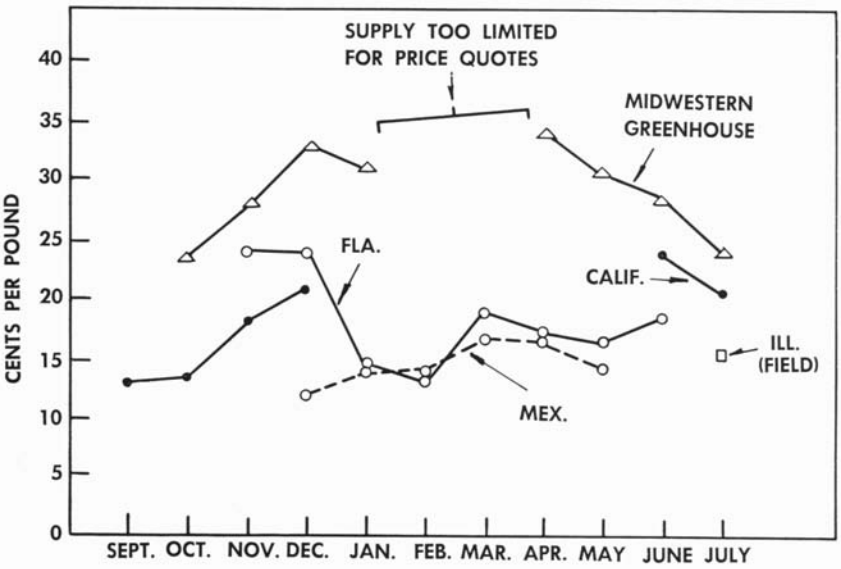
Consumers like greenhouse tomatoes

When local vine-ripe tomatoes are unavailable, greenhouse tomatoes are considered to be highest quality and bring the highest market prices. Consumer preference for greenhouse tomatoes over green-wrap tomatoes has been convincingly demonstrated in Michigan and Ohio, where more than two-thirds of consumers on test panels preferred the greenhouse tomatoes (4, 7). In the Ohio tests, greenhouse tomatoes were even preferred over vine-ripened field tomatoes. The Michigan study indicated that consumer selection of greenhouse tomatoes was greatly reduced when the price difference between greenhouse tomatoes and green-wraps was 20 cents a pound or more. Then, most shoppers bought the lower quality tomato because of its lower price.

Identification of the greenhouse tomato is a marketing problem of both the producer and the retail merchant. Since lower priced green-wraps may appear similar to greenhouse tomatoes, identification is essential for a competitive marketing program. Leaving the green calyx attached to the tomato has been a traditional mark of a greenhouse-grown tomato. The value of the calyx as a quality symbol, however, has been questioned by at least one study (7).

Marketing studies with both field and greenhouse tomatoes in Indiana (6) and Michigan (5) have shown that consumers prefer tomatoes with the greatest amount of color development, as long as they are not overripe.

Both red-fruited and pink-fruited varieties are available for greenhouse forcing. Generally, "pink" varieties are grown in Ohio and Illinois while "red" varieties are grown in Michigan and Indiana. The choice of variety depends on such varietal characteristics as fruit size and disease resistance; adaptability to regional environmental conditions; and preference of the intended market.



Average wholesale tomato prices, Chicago market, 1960-1963. (Fig. 10)

Price trends

The total supply of tomatoes on the market significantly affects the price level for greenhouse tomatoes. Although prices seldom follow the same pattern from year to year, general price trends are indicated in Figure 10. This chart shows average wholesale prices of midwestern greenhouse tomatoes at Chicago, 1960-1963. The prices generally represent sales of less than carload lots made by the first seller on the wholesale market (9). Price levels and trends similar to those at Chicago have been reported in Ohio and Kentucky markets (8, 13).

The months of January through April, when supplies of quality tomatoes are limited, appear to have great potential for marketing greenhouse tomatoes.

Marketing methods

Greenhouse producers in southern Illinois sell through existing marketing channels. These include brokers or wholesale commission merchants, food chains, or local outlets.

Individual growers in southern Illinois have to ship most of their tomatoes to distant markets. Not only must they have sufficient production to ship, but they must also compete with organized greenhouse tomato cooperatives in the greenhouse production areas of Toledo,

Greenhouse tomatoes are marketed in cardboard cartons holding 8 pounds. Sometimes the tomatoes are individually wrapped with paper. (Fig. 11)

Cleveland, Indianapolis, and Grand Rapids, and with large sales organizations in southern producing areas. The advantages of cooperative marketing can be realized only when volume is large enough to justify the cost of a strong marketing organization. It is estimated that at least 30 acres of greenhouse production are necessary for such an organization.

Local markets are limited although many towns can support a small greenhouse unit. In one southern Illinois town with 10,000 people, about 2,500 8-pound baskets of greenhouse tomatoes are sold locally during the spring harvest period (April, May, and June), for an average per capita consumption of 2 pounds. This town uses about as many tomatoes as can be produced in a greenhouse of 8,000 square feet.

Greenhouse tomatoes are unclassified or are sold by grades U. S. Fancy, U. S. No. 1, or U. S. No. 2. Within these grades, the tomatoes are sized as small (under 3½ ounces), medium (3½ to 9 ounces), and large (over 9 ounces).

Greenhouse tomatoes are generally marketed in 8-pound cardboard cartons, from which the tomatoes may be sold directly. The grade and size, together with the grower's name, are marked on the container. Graded tomatoes may be individually wrapped in special paper.

SUMMARY AND CONCLUSIONS

Growing vegetables in greenhouses is one of the most intensive forms of agricultural production. It involves a substantial investment in facilities with their accompanying fixed costs, as well as a large input of labor and skilled management. Essentially all environmental conditions are modified and controlled except sunlight. Careful management to efficiently utilize the available light can result in high yields, with correspondingly high returns. After the initial investment for facilities, the greatest input costs are for labor and fuel.

Factors such as low fuel costs, mild winters, good light conditions and proximity to Chicago and other consumer markets are advantages inherent to southern Illinois.

Capital investment and annual ownership costs are somewhat lower for plastic greenhouses than for glass greenhouses, assuming that outside labor does not have to be hired for constructing and maintaining the plastic houses. The advantage of plastic construction is reduced if off-the-farm labor must be hired.

High yields must be produced to justify the initial investment required for greenhouse facilities. This is especially true of temporary plastic greenhouses, whose apparent low-cost advantage is offset by the high rate of depreciation. The longer depreciation period for permanent or glass construction gives more opportunity to balance poor years with good ones.

Depending primarily on size, but also on the degree of permanence of the greenhouse facility, greenhouse tomato production can be either a primary or a supplementary source of income. Greenhouse production is well-suited for operation as a family enterprise.

Assuming a $20,000 annual acre cost to grow greenhouse tomatoes, the following are estimated returns to the manager-operator who can produce 20 pounds of tomatoes per plant per year:

Average price per basket	Approximate return
$1.50	$ 3,000
1.75	7,500
2.00	13,000
2.25	17,500

Florida, Mexico, and Texas are important sources of fresh tomatoes during the "greenhouse season." Supplies will continue to come from these production areas. Greenhouse producers must constantly strive for efficiency and improved marketing practices.

LITERATURE CITED

1. COURTER, J. W. Plastic greenhouses. Ill. Agr. Ext. Cir. 857. 1962.
2. _____. Greenhouse tomato production. Ill. Res. (Ill. Agr. Exp. Sta.) 6(3):14-15. 1964.
3. COURTER, J. W., and CURTIS, J. O. New rigid frame plastic greenhouse structures. Ill. State Florists Assoc. Bul. 246:2-3. 1964.
4. CRAVENS, M. E. The tomato consumer. Growers Handbook and 43rd Annual Proceedings, 1958. Ohio Veg. and Potato Growers Assoc. pp. 35-39.
5. DEDOLPH, R. R., and LARZELERE, H. E. Tomatoes — color development and consumer preference. Mich. Agr. Exp. Sta. Quart. Bul. 45(2):219-222. 1962.
6. GARRETT, A. W., AMMERMAN, G. R., DESROSIER, N. W., and FIELDS, M. L. Effect of color on marketing of fresh tomatoes. Proc. Amer. Soc. Hort. Sci. 76:555-559. 1960.
7. LARZELERE, H. E., and DEDOLPH, R. R. Consumer acceptance of greenhouse-grown and southern field-grown tomatoes. Mich. Agr. Exp. Sta. Quart. Bul. 44(3):554-558. 1962.
8. ROYER, E. J., and JEFFRIES, J. E. The 1964 spring crop tomato situation. Ohio State Univ. Agr. Econ. Mimeo 364. 1964.
9. U.S. DEPARTMENT OF AGRICULTURE. Fresh fruit and vegetable prices, 1960, 1961, 1962, 1963. Agr. Marketing Serv. Stat. Buls. 285, 307, 332, 347.
10. _____. Fresh fruit and vegetable unloads in eastern cities by commodities, states, and months, calendar years 1960, 1961. Agr. Marketing Serv. 427.
11. _____. Fresh fruit and vegetable unloads in midwestern cities by commodities, states, and months, calendar years 1962, 1963. Agr. Marketing Serv. 492.
12. U.S. DEPARTMENT OF COMMERCE, WEATHER BUREAU. Local climatological data, with comparative data. Cairo, Ill.; Cleveland, Ohio; Grand Rapids, Mich.
13. WOODROW, WILLIAM C., and SHUFFETT, D. MILTON. Prices for greenhouse tomatoes on the Louisville and Cincinnati markets. Univ. Ken. Misc. 304. 1963.

10M—8-65—86614