1-1-1980

An investigation of the feasibility of pick-your-own strawberries in Story County, Iowa

Rosalie Black Rollenhagen
Iowa State University

An investigation of the feasibility of pick-your-own strawberries in Story County, Iowa

by

Rosalie Black Rollenhagen

A Thesis Submitted to the

Graduate Faculty in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE

Co-majors: Agricultural Education
Horticulture

Approved:

Iowa State University
Ames, Iowa

1980

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The purpose of this study was to investigate the procedures and finances of establishing and managing a small pick-your-own strawberry farm in Story County, Iowa.

For purposes of this study, the farm size was set at 10 acres, with 5 acres devoted to strawberry production. The remaining 5 acres is assumed to be devoted to other fruit and/or vegetable production.

It was deemed necessary to delimit a geographical area for consideration. The geographical area chosen was Story County, Iowa. However, it is believed that this study has application to other counties in Iowa whose climate and soils are similar to those of Story County.

Iowa is primarily an agricultural state. The most important agronomic crops are corn and soybeans. Fruit and vegetables account for less than 0.2% of the state's total farm cash receipts (U.S.D.A, 1978). A large portion of the fruits and vegetables consumed by Iowans must be shipped into the state. Rising transportation costs contribute to higher marketing costs which are reflected in the price paid by consumers for fresh produce. This situation appears to provide a potential outlet for locally-produced fruits and vegetables.

The price of Iowa farmland has increased dramatically in the past decade (Table 1a). The value of Iowa farmland in 1979 was almost double the 1975 value. This situation has made it increasingly difficult for the newcomer with limited funds to purchase land. Even though loans may be available, soaring interest rates on that borrowed money may be prohibitive. Interest rates increased by more than 600% from 1967 to 1979. And,

as of February, 1980, interest rates were up 25% over the average 1979 cost (Kelsey, 1980). Other farm input costs have also risen as shown in Figure 1.

To make matters worse, farm returns have not kept pace with rising input costs. Corn and soybean prices have declined or risen only slightly in recent years (Table 1b).

Fruit and vegetable crops, in general, possess a high cash value per acre. Values of $3000 to $5000 per acre are not uncommon. The critical issue, however, is not one of cash values per acre, but rather, is one of profits per acre. Fruits and vegetables are labor-intensive and materials-intensive crops. Consumers demand unblemished produce of the highest quality. To achieve such a product, the farmer must be capable of making a high investment per acre.

The question arises: could Iowa farmers profit by diversifying their enterprises to include some fruits and vegetables? The climate and soils of Iowa are suitable for the culture of a variety of horticultural crops. This study will focus on one such crop -- strawberries.

Furthermore, the specific emphasis of this study will be the small farm of 10 acres or less. It is presently very difficult for the newcomer with limited capital to get started in farming. He or she cannot afford to purchase a large acreage nor the equipment required to farm the large acreage.

What are the capital and labor investments required to grow and market 5 acres of strawberries? What returns and profits can be expected? Answers to these questions are the focus of this research.

Table 1a. Recent increases in Iowa farmland values (Harris et al., 1980)

Year	Value per acre	Dollar change	Percentage change
1965	320	29	10.0
1966	361	41	12.5
1967	397	36	9.9
1968	409	12	3.0
1969	419	10	2.5
1970	419	0	0.0
1971	430	11	2.6
1972	482	52	12.0
1973	635	154	31.9
1974	834	199	31.3
1975	1095	261	31.3
1976	1368	273	24.9
1977	1450	82	6.0
1978	1646	196	13.5
1979	1958	312	19.0

Table 1b. Average prices received by Iowa farmers (Harris et al., 1980)

Year	Corn	Soybeans
1974	$2.87/bu	$6.39/bu
1975	2.66	5.23
1976	2.45	5.54
1977	1.98	6.79
1978	2.04	6.18
1979	2.25	6.71

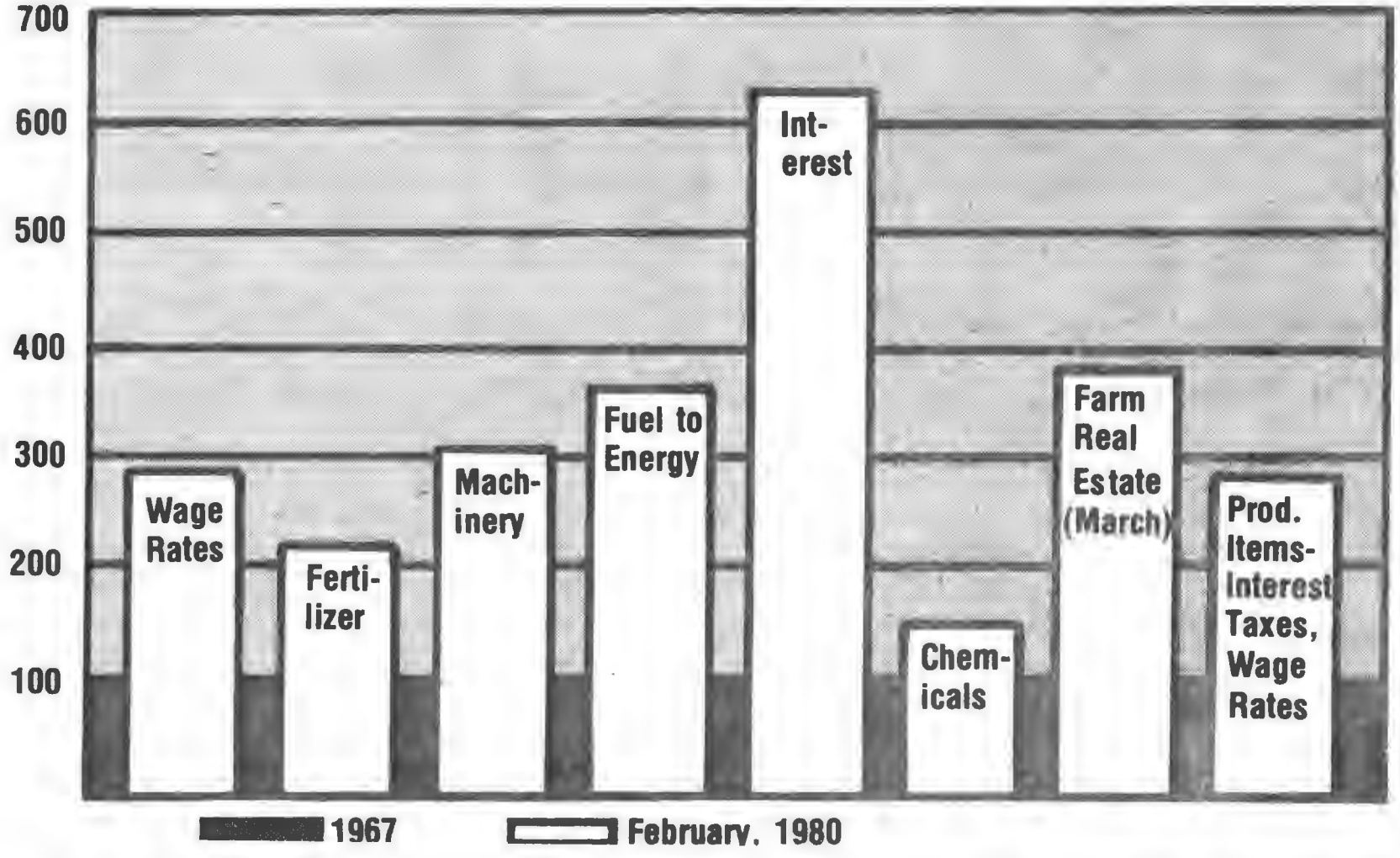

Figure 1. Prices of selected farm inputs, % of 1967 (U.S.D.A., 1980)

When embarking on any agricultural endeavor, certain environmental conditions must be considered as fixed factors. Fixed factors are those over which the farmer has little or no control. The most important of these are climate and soils. In the following two sections, a brief discussion of the climate and soils of Story County is provided in order to enhance the reader's understanding of the setting within which the Story County farmer must operate.

With this climatic and soil background in mind, a section on cultural considerations follows. In this section, the cultural practices outlined in Tables 13 and 14 are explained in detail.

Once a crop has been produced, the farmer must market the crop. In the section entitled "Pick-Your-Own Marketing," the factors involved in pick-your-own marketing are considered.

Analyses of fixed costs, variable costs, and total costs may be found under the appropriate section titles. Expected returns are then projected.

Finally, the findings are discussed and conclusions are made, based on the findings of the study.

CLIMATE OF STORY COUNTY

The average number of days in Story County without killing frost is about 155 days (Figure 2). The mean date of the last spring freeze is April 28 and the mean date of the first fall freeze is November 10 (N.O.A.A., 1974). Spring freezes often damage strawberry blossoms, thereby reducing yields. Appropriate control measures are discussed in the section entitled "Cultural Considerations."

The mean minimum temperature for Story County in January (the coldest month) is about 11°F (Figure 3). The mean maximum temperature in July (the warmest month) is about 88°F (Figure 4). Temperatures as low as -30°F and as high as 100°F have been recorded (N.O.A.A., 1974). Such temperature extremes are hazardous to strawberry plants. Healthy plants are less likely to suffer damage. Appropriate control measures are discussed in "Cultural Considerations."

The average annual precipitation for Story County is about 31 inches (Figure 5). The prevailing northwesterly flow of dry Canadian air during the winter months causes this season to be relatively dry. The prevailing southerly flow of moist air from the Gulf of Mexico during the summer months causes this season to be relatively wet (Table 2). Occasionally, hot, dry winds from the southwestern United States move into central Iowa in the summer, producing unusually high temperatures and drought (Waite, 1967).

Table 2. Normal precipitation in inches for Ames, Story County, Iowa (N.O.A.A., 1974)

Month	Precipitation
January	1.08
February	0.98
March	1.88
April	2.59
May	4.28
June	5.21
July	3.31
August	3.85
September	3.30
October	2.00
November	1.62
December	1.02
Annual	31.12

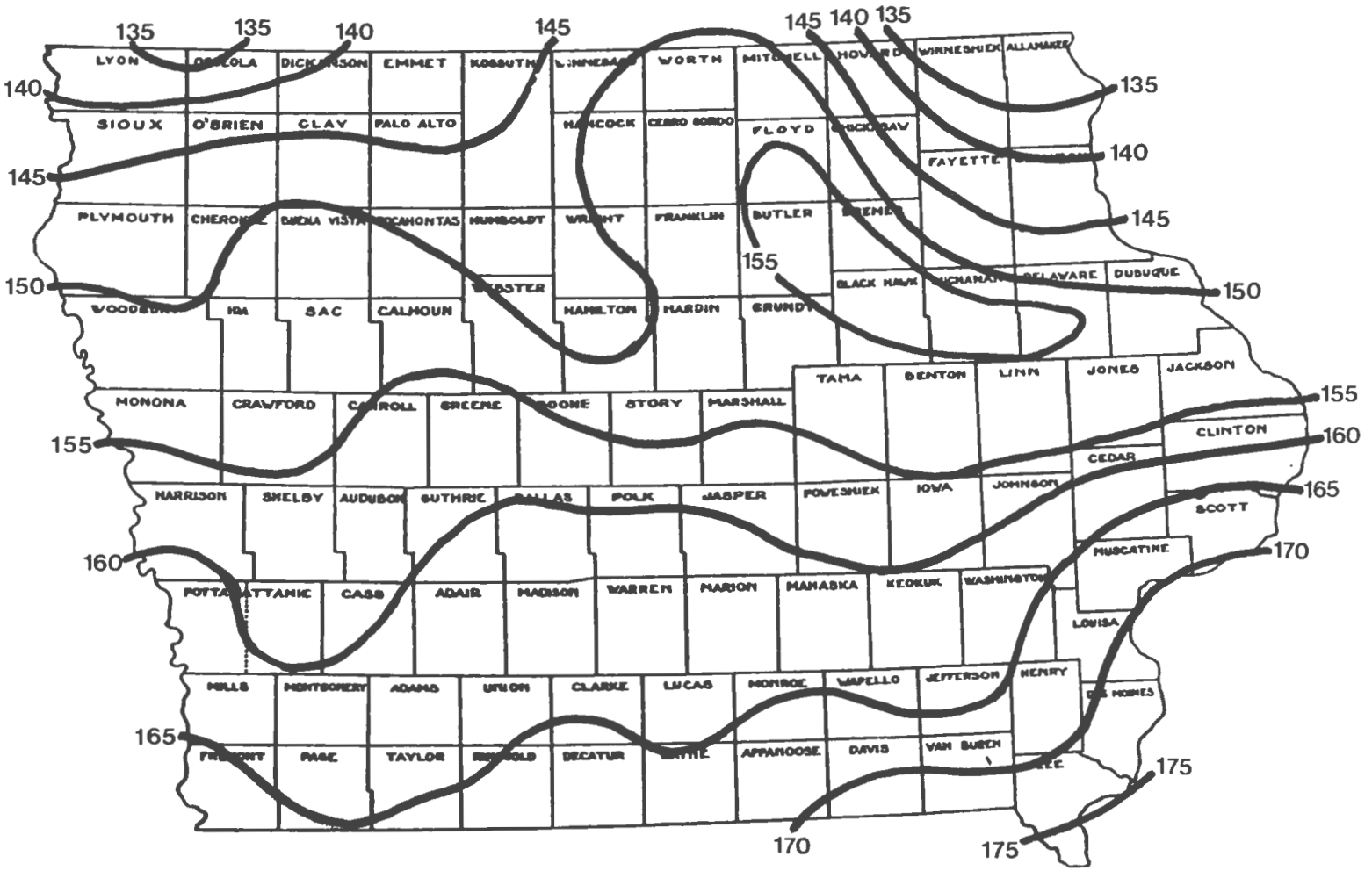

Figure 2. Average number of days in Iowa without killing frost (Oschwald et al., 1965)

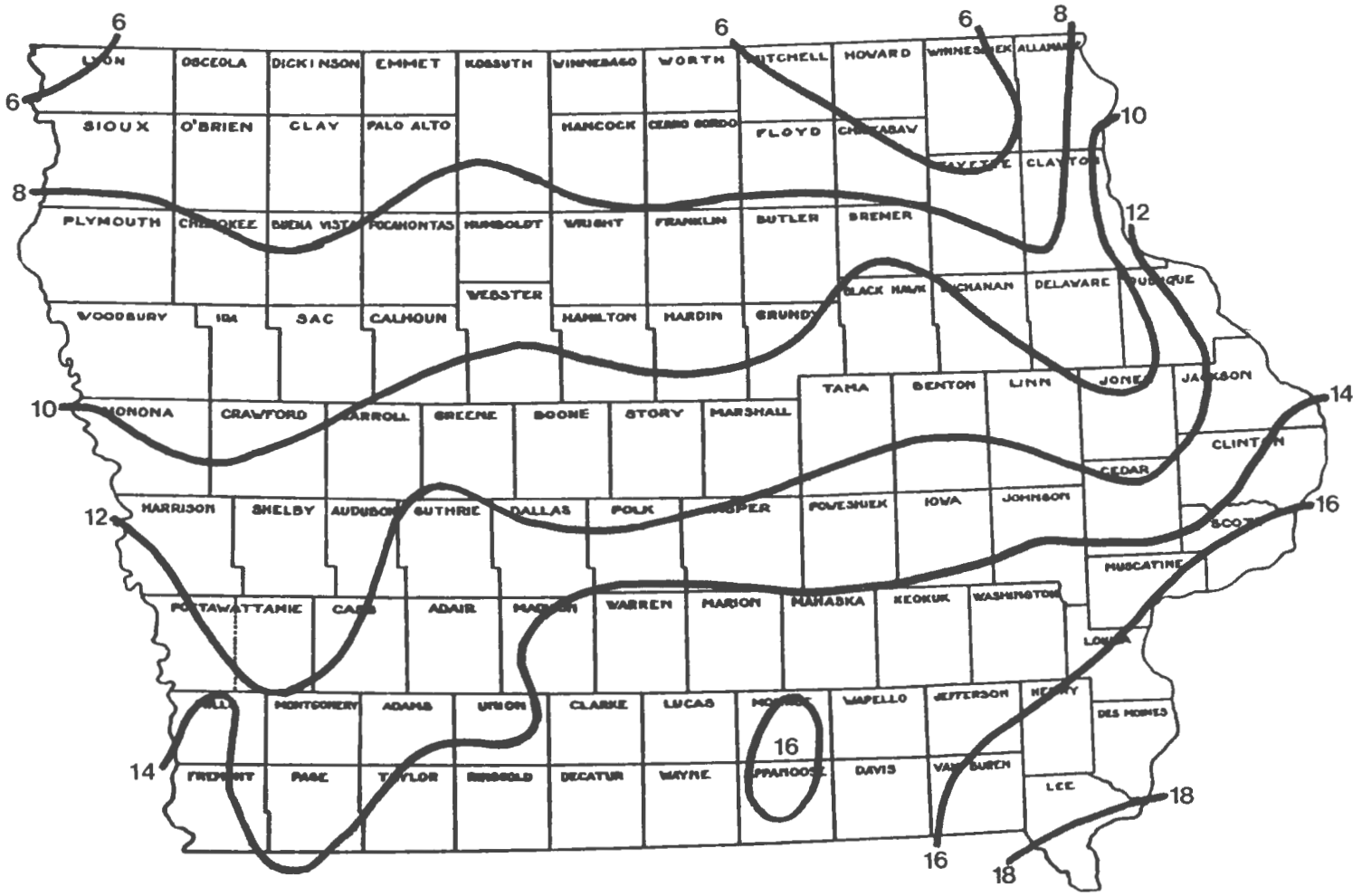

Figure 3. Mean minimum temperature (^{o}F) in January (N.O.A.A., 1974)

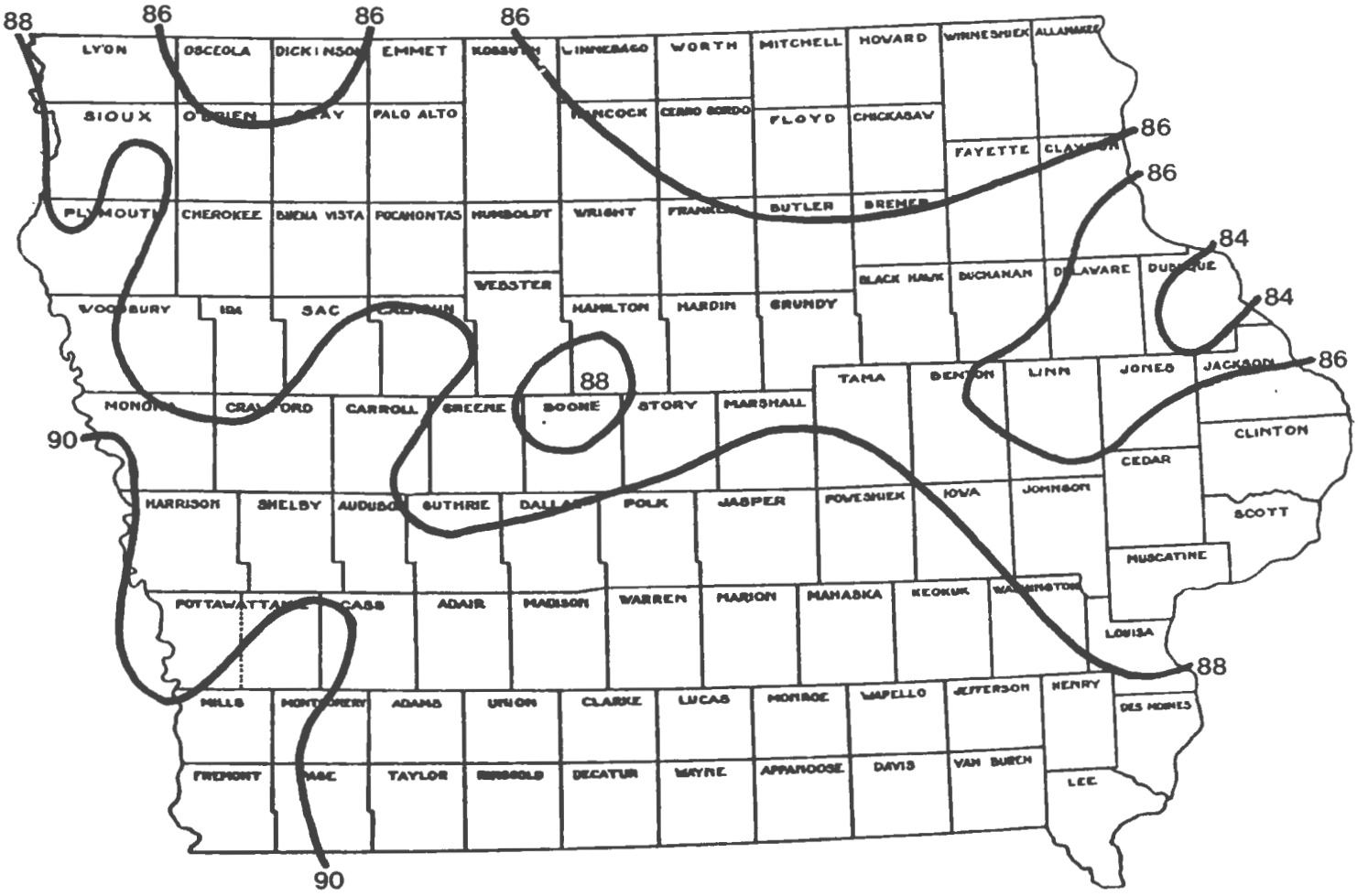

Figure 4. Mean maximum temperature (^{o}F) in July (N.O.A.A., 1974)

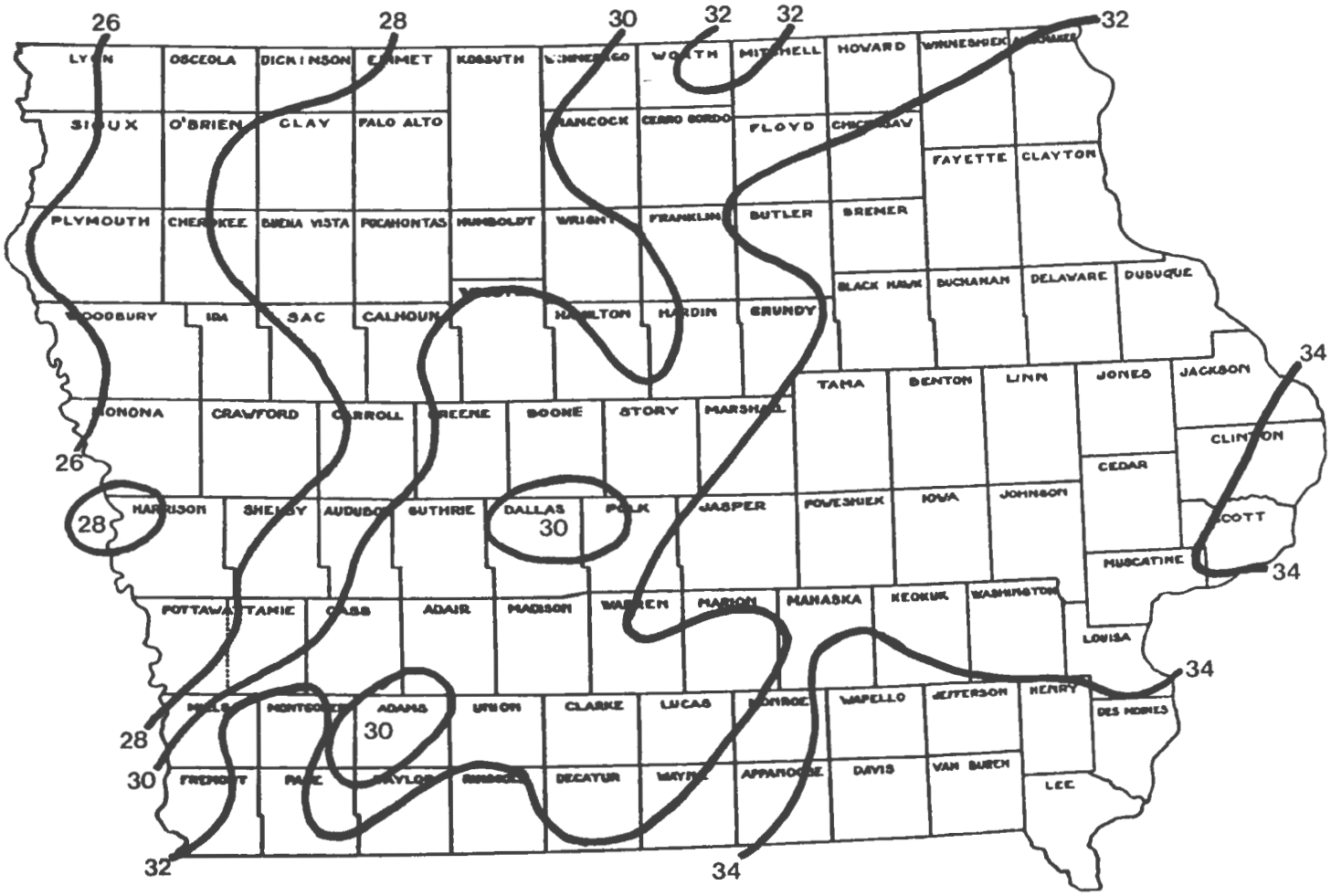

Figure 5. Average annual Iowa precipitation in inches (N.O.A.A., 1974)

SOILS OF STORY COUNTY

Story County is part of the Clarion-Nicollet-Webster soil association area (Figure 6). The major soils of this association are characterized by high water-holding capacity (Table 3). In some areas, the poor drainage of these soils has been improved by artificial drainage with tile and open ditches.

The topography of this area is nearly level to gently sloping, though some steep slopes do occur. The ideal site for growing strawberries is one which slopes sufficiently to allow natural air drainage, but not so steeply as to allow water erosion.

A critical soil requirement for growing strawberries is adequate water drainage (Childers, 1976; Shoemaker, 1975). For this reason, strawberries grow best on sandy loams and grow poorly on heavy clay soils (Craig, 1978).

The loam soils of Story County are capable of producing good crops of strawberries. The most serious natural limitation to strawberry growers in this area is probably good soil drainage. Poor soil water drainage results in weak root growth which is accompanied by various root rot diseases. Some growers are presently experimenting with raised beds, a cultural system which is widely used in Florida and California. More research needs to be done to examine the suitability of the raised bed system to strawberry culture in Iowa.

The Soil Conservation Service has prepared detailed soil survey maps of all counties in Iowa. The prospective grower should consult local

agents to obtain a soil survey map of the proposed site. A thorough knowledge of the capabilities and limitations of the site is essential.

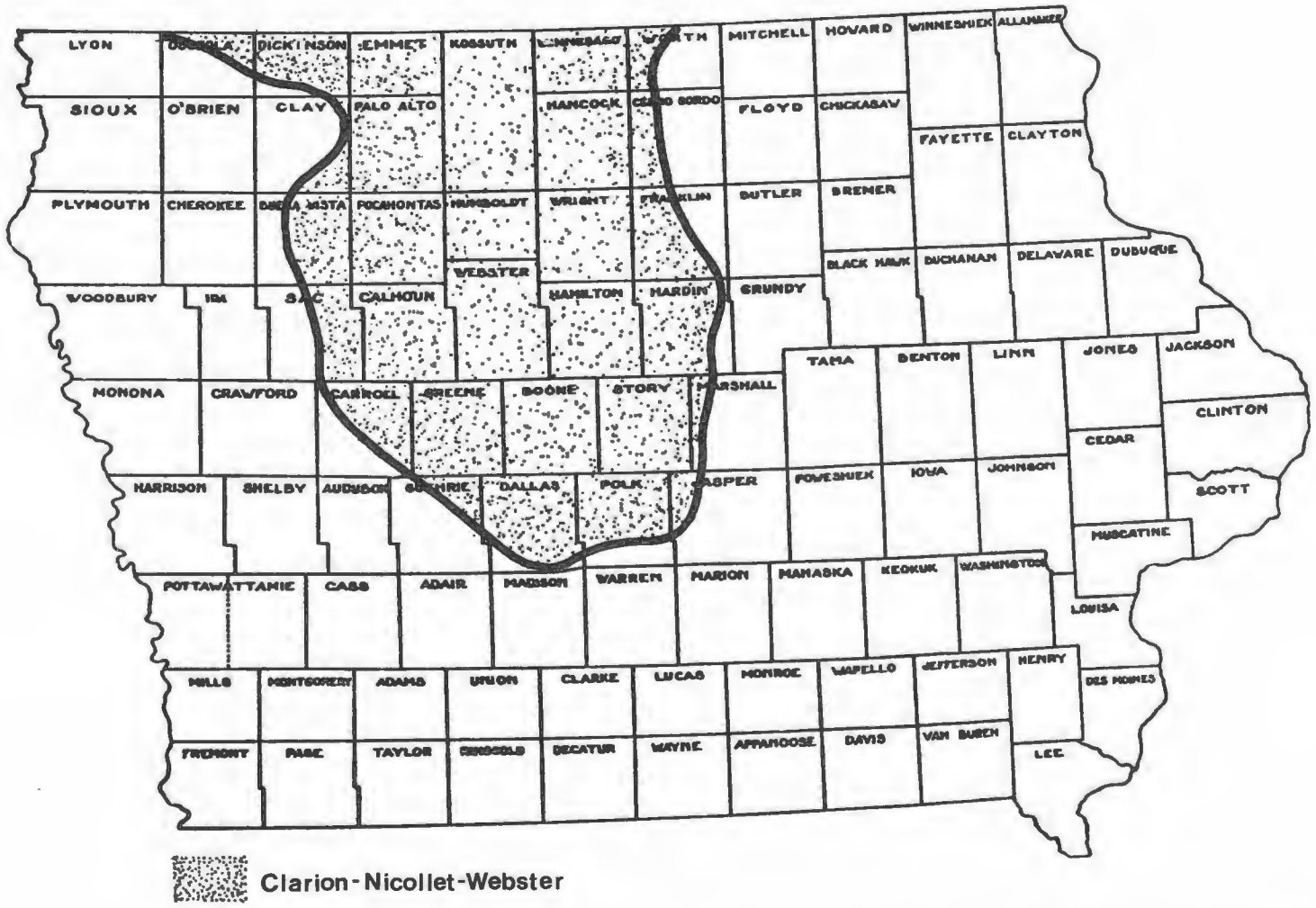

Figure 6. Iowa counties in the Clarion-Nicollet-Webster soil association area (Oschwald et al., 1965)

Table 3. Information about major soil types in Clarion-Nicollet-Webster soil association area (Oschwald et al., 1965)

Soil type	Slope percent		Land position	Erosion hazard	Natural internal drainage	Plant-available water-holding capacity to 5 feet
	Typical	Range				
Clarion loam	2-5	2-30	Upland highs and ridges	Slight to severe	Good	High
Nicollet loam	1-3	0-5	Upland intermediate highs	Slight	Somewhat Poor	High
Webster silty clay loam	0-2	0-3	Upland flats	None	Poor	High

CULTURAL CONSIDERATIONS

Cultivars and plant spacing

The choice of cultivars will be determined by environmental, cultural, and marketing factors. Consult with your county extension agent and local growers for suggestions. For pick-your-own marketing, choose both early-season and mid-season cultivars. Pick-your-own customers perfer large berries (Courter et al., 1978). If possible, choose cultivars resistant to leaf scorch, leaf spot, red stele, and *Verticillium* wilt. Table 4 lists characteristics of some cultivars which might be considered for planting in central Iowa.

The grower should order plants at least one year in advance of planting to assure availability of desired cultivars. Order from a nursery which sells only certified disease-free plants.

This study assumes that the grower will use the matted-row training system. The matted row requires less hand labor than other training systems. Plants are set 18 to 42 inches apart in rows three to four feet apart (Childers, 1976). Most of the runners that form during the first season are allowed to take root, forming a mat of plants. Harvesting is easier if the matted row is maintained at a width of two feet or less (Craig, 1978). Picking aisles between the rows may be 12 to 24 inches wide.

Plant spacing in the row will be determined by the vigor of cultivars in producing runners. Spacing between rows will be determined by the wheel tread of machinery. Number of plants required per acre at different plant spacings are listed in Table 5. For this study, it was assumed that the plant spacing would be 3½ ft x 2 ft, resulting in 6223 plants per acre.

Table 4. Characteristics of selected strawberry cultivars (Scott et al., 1979)

Cultivar	Ripening: days after Sunrise	Fruit quality: Fruit size	Fruit quality: Flesh firmness	Fruit quality: Skin firmness	Fruit quality: Dessert quality
Sunrise	0	Large	Firm	Firm	Good
Earliglow	0	Medium	Firm	Firm	V. good
Cyclone	3	Large	Soft	Soft	V. good
Surecrop	5	Large	Firm	Medium	Good
Stoplight	7	Medium	Soft	Medium	Good
Redchief	7	Large	Firm	Firm	Good
Guardian	7	V. large	Firm	Firm	Good
Midway	10	Large	Firm	Firm	Good
Delite	12	Large	Medium	Firm	Fair
Sparkle	12	Small	Soft	Soft	V. good

V. = very
Res. = Resistant
Susc. = Susceptible
Int. = Intermediate

	Disease resistance			
Processing quality for freezing	Leaf spot	Leaf scorch	Red stele	Verticillium wilt
Fair	V. Susc.	Res.	Res.	Res.
V. good	Res.	Res.	Res.	Res.
Good	Res.	Unknown	Susc.	Unknown
Good	Res.	Res.	Res.	V. res.
V. good	Int.	Int.	Susc.	Unknown
V. good	Res.	Res.	Res.	Int.
Fair	Res.	Res.	Res.	Res.
V. good	Susc.	Susc.	Res.	Int.
Unknown	Res.	Res.	Res.	Res.
V. good	Susc.	Int.	Res.	Susc.

Table 5. Strawberry plants required at different spacings

Distance (feet)	Plants to the acre	Distance (feet)	Plants to the acre	Distance (feet)	Plants to the acre
3 x 1	14,520	3½ x 1½	8296	4 x 1	10,890
3 x 1½	9,680	3½ x 2	6223	4 x 1½	7,260
3 x 2	7,260	3½ x 2½	4980	4 x 2	5,445
3½ x 1	12,446	3½ x 3	4148	4 x 2½	4,356

Preparation for planting

Preparation of the strawberry field begins the fall before planting. The seedbed is prepared and rye is seeded at 2 bushels per acre. Early the following spring, the rye is plowed under to increase the organic matter content of the soil. Other green manure crops which can be used in place of rye are oats, millet or sudangrass (Craig, 1978).

This study assumes that the soil is fumigated the fall before planting with a mixture of 67% methyl bromide plus 33% chloropicrin. This process destroys many weeds, diseases, and insects. Unfortunately, these chemicals also kill non-target microorganisms and earthworms. If there are no special disease, weed or insect problems on the proposed site, and, if a good crop rotation system is followed, soil fumigation will probably not be necessary.

Nearly any row crop can be used in rotation with strawberries. Specifically avoid tomatoes, peppers, potatoes, eggplants, and raspberries. These crops are susceptible to *Verticillium* wilt whose spores may carry over in the soil and infect the strawberry planting (Craig, 1978).

Planting

Transplanting by hand has been estimated to require 45 labor-hours per acre (Kirschling and Sullivan, 1979). With the aid of a two-row transplanter, this operation has been estimated to require 1½ labor-hours per acre (Kelsey and Johnson, 1979).

Blossom removal

It is essential that flower blossoms be removed the year of planting. Blossom removal stimulates early runnering (Craig, 1978). Runners which root early in the season will be more productive than those which become established in late summer (Davis, 1922). The blossoms should be removed when the entire stalk can be picked off. It may be necessary to go over the planting two or three times. In this study, it was assumed that the blossom removal operation would require 16 labor-hours per acre (Kelsey and Johnson, 1979). This operation, performed twice, requires a total of 32 labor hours per acre.

Cultivation

Mechanical cultivation is necessary between rows to eradicate weeds. As the matted row expands during the growing season, the cultivation strip becomes more narrow until the desired row width is obtained. Cultivation close to the expanding row loosens the soil and provides for easy rooting of runners (Stadelbacher, 1978b). Cultivate the same direction each time to avoid disturbing newly-rooted runners (Stadelbacher, 1978b).

Hand hoeing

Even with the use of herbicides, some hand hoeing in the row will probably be necessary to insure a weed-free field. If the matted row is becoming too dense, some strawberry plants can also be hoed out at this time. The ideal spacing between plants is 4 to 6 inches (Craig, 1978).

For purposes of this study, hand hoeing was assumed to require 10 hours per acre per time during the first growing year and 16 hours per acre per time thereafter (Kelsey and Johnson, 1979).

Fertilization

Fertilizer practices will vary from grower to grower depending on soil type, soil fertility, availability, and personal preference. A soil test should be made to determine the fertilizer requirements of the particular soil. In this study, it was assumed that a soil test indicated a need for 100 pounds of P_2O_5 and 100 pounds of K_2O per acre. Because phosphorus and potassium are relatively immobile elements, the fertilizers are incorporated into the soil before planting (Doll, 1978). In addition, a starter fertilizer solution (6 lbs. of 10-50-10/100 gal. of water) is prepared at planting. One-half pint of this solution per plant is applied (Doll, 1978). Phosphorus is important in promoting root growth which enables the plants to become established quickly (Stadelbacher, 1978a).

A broadcast application of 100 lbs ammonium nitrate (33 lbs. actual nitrogen) is made 2 weeks after planting. Broadcast applications of nitrogen fertilizer must be brushed off or washed off the leaves with sprinkler irrigation to avoid damage to the foliage (Ourecky, 1976).

An additional broadcast application of 100 lbs ammonium nitrate per acre is made between August 15 and September 1. This aids in flower-bud formation for the following year's crop (Doll, 1978).

In the following crop years, nitrogen fertilizer is applied as 100 lbs of NH_4NO_3 per acre during renovation. Except on very sandy soils, nitrogen fertilizer should never be applied in the spring of the fruiting year. Nitrogen fertilization at this time is likely to result in dense foliage, soft berries, increased fruit rot, and delayed fruit maturity (Doll, 1978).

Pest control

Weed, insect, and mite control is essential to consistently high production of good-quality berries (Ourecky, 1976). The kinds of pesticides and herbicides used will vary from grower to grower, but the spray program outlined in this study is believed to be an example of one which would give adequate control. The amounts of each product per acre are those specified on the product labels.

The grower must be careful to follow label directions concerning the minimum allowable number of days between application and harvest. Application of any pesticide in a manner inconsistent with label directions is illegal.

Mulching

The problem of winter injury may be avoided if a 2-3 inch deep mulch of clean, dry straw is applied over the plants in the late fall (Shoemaker, 1975). The mulch should be applied after the plants have been exposed to several light frosts, but before temperatures drop below 20°F (Shoemaker,

1975). Mulch acts as an insulator, protects the plants from temperature fluctuations, and provides a more uniform plant temperature throughout the winter months. A heavy snow cover has a similar insulating effect.

The winter mulch is removed in the spring when danger of severe frost is past, but before the expanding foliage yellows from lack of light (Shoemaker, 1975).

Frost control

Spring frost damage may be avoided by use of low-volume sprinkler application of 1/10 inch water per acre per hour (Shoemaker, 1975). The water should be turned on when the temperature drops to 34°F at the lowest point in the field. Sprinkling must continue until the air temperature is high enough to have melted all ice from the plants (Shoemaker, 1975). In the following variable cost budgets, it was assumed that frost control would be necessary five nights per season of 8 hours per night for a total of 40 hours per season of 1/10 inch per hour equals 4 acre-inches per season.

Irrigation

During occasional periods of early summer drought, irrigation can make the difference between a bumper crop of strawberries and a poor crop. Supplemental irrigation after renovation also ensures a vigorous, healthy stand of plants to produce the next year's crop.

The soil should be thoroughly soaked at each application. One acre-inch of water per application is the standard recommendation (Ourecky, 1976). Soil tensiometers may be used to determine the optimum timing for irrigations.

Renovation

Immediately after harvest, the strawberry beds should be renovated (Skirvin and Otterbacher, 1979). First, the foliage is mowed off, taking care not to damage the crowns. Then, the matted rows are narrowed to 6 to 12 inches with the aid of a rototiller. This process may be accomplished by various methods (Skirvin and Otterbacher, 1979). One method is to narrow the row from both sides leaving a narrow strip of plants in the middle. An alternative method is to remove one-half of the row one year and then remove the opposite half of the row the following year. A third method is to remove a strip down the middle of each row.

Fertilizer applications, irrigation, and herbicide applications are made as needed at this time.

PICK-YOUR-OWN MARKETING

Growing a good crop of strawberries is only half the picture; the other half is successful marketing. In recent years, pick-your-own ("PYO" or "U-pick") has gained popularity with both growers and consumers. A wide variety of fruits and vegetables are presently marketed by this method. The pick-your-own method of marketing is especially suited to strawberries because of the great amount of hand labor required to harvest this crop. A grower may have difficulty in hiring adequate labor to harvest berries during the relatively short picking season. High-yielding fields may require 8 to 10 pickers per acre (Childers, 1976). Even if adequate picking labor is available, the cost to harvest will be high. A 1979 Michigan study estimated harvesting costs for 8400 pounds of strawberries to be $2,095 or about 25¢ per pound. In comparison, I have estimated the costs of PYO marketing in 1980 to be $893 for 10,000 pounds or about 9¢ per pound (Table 17).

Kirschling and Sullivan (1979) have pointed out another advantage of PYO marketing:

> Wholesale marketing channels require large volumes of produce, uniform specification as to grade and quality, and large amounts of grading and packaging at the point of production. This makes profitable penetration of wholesale markets very unlikely for small producers. PYO can effectively bypass all these problems for small farmers who have access to markets with sufficient people and demand.

What constitutes "sufficient people and demand?" Studies in Illinois have shown that the average pick-your-own strawberry customer travels about 20 miles to the farm and picks approximately 23 pounds of fruit (Courter et al., 1979; Courter and Sabota, 1980). These averages provide a basis

for estimating the number of customers required to harvest an acre of strawberries. Assuming an average purchase of 23 pounds, harvest of 6000 pounds of berries would require 261 customers. An 8000-pound harvest would require 348 customers, and a 10,000-pound harvest would require 435 customers per acre or 2174 customers per five acres.

The population of Story County is 61,518. Ames (pop. 44,983), the largest town, should be considered as part of the primary trade area for a pick-your-own market in Story County.[1] Des Moines (pop. 186,044), located about 30 miles south of Ames, should be considered as part of the secondary trade area.[2]

Various factors have been cited as criteria for success in pick-your-own marketing. These include (Antle, 1978):

1. Long hours - hard work;
2. Must like people;
3. Family operation;
4. Honest employees;
5. Involve family in profit of operation;
6. Give customers individual attention;
7. Be prompt, courteous and friendly;
8. Many people within half-hour drive;
9. Grow produce of top quality;

---

[1]The primary trade area is defined as the area surrounding the farm where 75% of the closest customers live (Courter and Sabota, 1980).

[2]The secondary trade area is defined as the region extending beyond the primary trade area where an additional 15% of the customers live (Courter and Sabota, 1980).

10. Have neat, well-kept buildings and grounds;
11. Provide adequate parking;
12. Be able to handle overflow crowd;
13. Advertise as much as results warrant;
14. Be known for a specialty;
15. Have attractive signs;
16. Have a brochure of farm;
17. Give instructions for produce use;
18. Have regular hours -- keep well publicized;
19. Make improvements regularly -- use in publicity;
20. Show people how to harvest and handle produce;
21. Location easy to find on or near a good road.

The results of a survey distributed to pick-your-own customers in Illinois suggest that quality fruit is the most important reason for selecting one farm over another (Courter and Sabota, 1980). Closeness to the farm or convenience was cited as the second most important reason for choosing a particular farm. Lowest price was far less important than quality or convenience.

It should be noted that the cost of advertising was not analyzed in this study. The numerous promotional options available make it difficult to provide an accurate estimate. The prospective grower should keep in mind that some form of advertising is essential for successful marketing.

FIXED COSTS

Fixed costs are those costs which are incurred regardless of whether or not a crop is produced. Fixed costs are "fixed" in that they do not vary with level of production.

Fixed costs of equipment

Two alternative sets of equipment were selected for the small farm enterprise. The first set, based on a Sears 16 hp garden tractor, is considered minimal in size and purchase cost for a fruit-growing enterprise of 10 acres. The second set, based on a 27 hp John Deere tractor, is larger than the Sears equipment and initially more expensive.

Fixed costs of the Sears equipment are presented in Table 6. Fixed costs of the John Deere equipment are presented in Table 7. The choice of implements for each set of equipment was based on the tractor type and size. The Sears garden tractor is not equipped with power-take-off. Hence, attachments, such as the rototiller and the sprayer must supply their own power.

The weed sprayer, pick-up truck and irrigation equipment are the same for both sets of equipment. Purchase prices for the various components of the frost control system are listed in Table 8. It was assumed that the farm already had an adequate source of water. The power-take-off pump was selected as the least expensive type of pump in initial purchase cost.

Frost control equipment is expensive and constitutes a sizable portion of the initial machinery investment. However, some method of frost

Table 6. Fixed costs of Sears equipment

Item	1980 Purchase cost[a]	Salvage value[b]	Depreciable value	Life (yrs)	Average annual investment	Annual fixed cost[c]
Sears 16 hp garden tractor	$ 2125	$ 213	$1912	5	$1169	$ 555
Sears 1-bottom plow	160	16	144	3	88	61
Sears 40" disc	140	14	126	3	77	53
Sears cultivator	125	13	112	3	69	47
Sears 38" 8 hp gas-powered rototiller	600	60	540	3	330	229
Sears spreader-seeder	110	11	99	3	61	42
Sears 42" rotary mower	400	40	360	3	220	153
Sears 40" drag harrow	130	13	117	3	72	50
Subtotal	6940					1190
Solo Trac-419 T with tank, trailer	1500	150	1350	10	825	392
Weed sprayer	600	60	540	10	825	392
Pickup	5500	550	4950	10	3025	943
Irrigation system	9000	900	8100	15	4950	1273
Total	$23,540					$3901

[a]Does not include taxes or delivery charges.

[b]Based on 10% of purchase cost.

[c]Includes depreciation, interest at 12% on average annual investment and property tax, insurance and housing at 2.8% of average annual investment.

Table 7. Fixed costs of Deere equipment

Item	1980 purchase cost[a]	Salvage value[b]	Depreciable value	Life (yrs)	Average annual investment	Annual fixed cost[c]
John Deere 950 tractor, 27 PTO hp	$7050	$1763	$5287	10	$4406	$1181
John Deere 2-bottom plow	1032	258	774	8	645	192
John Deere 7'8" disc	989	247	742	8	618	184
Multivator tiller	2050	513	1537	8	1282	382
John Deere spin spreader	794	199	595	8	497	148
John Deere 72" rotary mower	1379	345	1034	8	862	257
John Deere drag harrow	723	181	542	8	452	135
2-row mechanical transplanter	1008	252	756	8	630	188
Subtotal	$15,025					$2667
Broyhill 1950 rowcrop sprayer	2500	250[d]	2250	10	1375	429
Weed sprayer	600	60[d]	540	10	330	103
Pickup	5500	55[d]	4950	10	3025	943
Irrigation system	9000	900[d]	8100	15	4950	1273
Total	$32,625					$5415

[a]Does not include taxes or delivery charges.

[b]Based on 25% of purchase cost.

[c]Includes depreciation interest at 12% on average annual investment and property tax, insurance, and housing at 2.8% of average annual investment.

[d]Based on 10% of purchase cost.

Table 8. Purchase cost of frost control-irrigation equipment

Item	1980 purchase cost
PTO pump	$1500
35 hp tractor (used)	3000
Subtotal	$4500
4" pipe (1050 ft. @ $1.22/ft.)	1281
2" pipe (3150 ft. @ $.67/ft.)	2111
52 sprinklers @ $11.50/sprinkler	598
Miscellaneous	510
Subtotal	$4500
Total	$9000

control is essential for consistent production of high strawberry yields. The first blossoms to open in the spring are the so-called "king blossoms" which produce the largest berries (Dana, 1980). Consequently, without frost protection, the largest berries are the most likely to be lost or damaged. In a sense, the commercial strawberry grower cannot afford *not* to have frost control. Also, the sprinkler equipment for frost control doubles as irrigation equipment. Irrigation is likewise considered essential for consistently high yields of quality berries.

Purchase costs for all equipment are 1980 manufacturers' list prices. Salvage values are based on 10% of purchase price for the Sears equipment (Kirschling and Sullivan, 1979), and 25% of purchase price for the Deere equipment (Ayres and Boehlje, 1979).

Depreciable value = purchase cost - salvage value (Ayres and Bochlje, 1979).

Economic life assumptions may not be accurate, but are believed to be within the realm of reason. Estimates were based on information obtained from various sources (Kirschling and Sullivan, 1979; Kelsey and Price, 1979), as well as discussions with local suppliers.

Average annual investment = $\frac{\text{purchase cost + salvage value}}{2}$

(Ayres and Boehlje, 1979).

Annual fixed cost = annual depreciation + interest at 12% on average annual investment + property tax, insurance, and housing at 2.8% of average annual investment (Ayres and Boehlje, 1979), where annual depreciation = depreciable value ÷ economic life in years.

Fixed costs per acre

Fixed costs per acre are itemized in Tables 9 and 10.

Fixed costs of equipment are based on the assumption that the machinery is used equally for each of the 10 acres of the diversified farm. The annual fixed cost (from Tables 6 and 7) divided by 10 acres equals the fixed equipment cost per acre.

The average value for high-grade farmland in central Iowa is about $3000 per acre (Harris et al., 1980). Based on interviews with local loan officers, the interest rate was set at 10%.

Land taxes were estimated to be $15 per acre, based on interviews with local persons.

The pick-your-own grower must carry both crop and liability insurance. It should be noted that the cost of such insurance has not been included in this study. Insurance is highly variable and reliable estimates could not be obtained.

Table 9. Annual fixed costs per acre using the Sears equipment

Item	Cost
Equipment	$390.10
Interest on land ($3000 x .10)	300.00
Taxes	15.00
Total annual fixed costs per acre	$705.10

Table 10. Annual fixed costs per acre using the Deere equipment

Item	Cost
Equipment	$541.50
Interest on land ($3000 x .10)	300.00
Taxes	15.00
Total annual fixed costs per acre	$856.50

VARIABLE COSTS AND TOTAL COSTS

Variable costs

Variable costs are the costs of growing and harvesting a crop. These costs are "variable" because they are directly related to the level of production. If no crop was planted, variable costs would be zero.

Strawberry growing costs

Growing costs for strawberries are itemized in Tables 13 and 14. Each operation required to produce strawberries has been itemized, starting in the fall of the establishment year and continuing up to harvest of the second crop year. Each operation has been broken down into labor, machinery, and materials requirements.

Estimates of the time required to perform hand labor operations are based on figures obtained from "Small Farm Costs and Returns: Pick-Your-Own Strawberries" (Kirschling and Sullivan, 1979), and "Costs of Strawberry Production in Southwestern Michigan" (Kelsey and Johnson, 1979).

Estimates of the time required to perform operations with the given equipment are based on calculations made using the following formula (Ayres and Boehlje, 1979).

$$\text{EFC (acres/hour)} = \frac{\text{width (feet)} \times \text{speed (mph)} \times \text{FE}}{8.25}$$

where:

EFC = effective field capacity, the actual field capacity of a machine;

width = width of the machine

speed = speed of the machine (estimated as 2.0 mph for the Sears tractor and 2.5 mph for the John Deere tractor);

FE = field efficiency; the percentage of a machine's theoretical field capacity actually achieved under real conditions (estimated as .85 for both Sears and John Deere tractors);

$$8.25 = \frac{43{,}560 \text{ sq. ft/acre}}{5280 \text{ ft/mile}} \quad .$$

For example, the effective field capacity of the Sears 16 hp tractor with 10" one-bottom plow was estimated to be:

$$\frac{\frac{10}{12} \times 2.0 \times .85}{8.25} = 0.2 \text{ acres/hour.}$$

In other words, it would take about five hours to plow one acre with the Sears tractor and plow.

In comparison, the effective field capacity of the John Deere 27 hp tractor with 12" two-bottom plow was estimated to be:

$$\frac{2 \times 2.5 \times .85}{8.25} = 0.5 \text{ acres/hour} \quad .$$

In other words, it would take about two hours to plow one acre with the John Deere tractor and plow.

The wage rate for all labor performed is assumed to be $4.00 per hour. The operator who performs much of the labor herself will have lower cash labor costs than those itemized in Tables 13 and 14. However, inclusion of all labor as a cash expense is one way of calculating the opportunity cost to the operator of devoting his or her time to growing strawberries rather than to some other occupation.

Costs of materials are 1980 prices from local suppliers.

Variable costs of machinery or operating costs include fuel, lubrication, and repairs.

Fuel costs per hour were estimated as follows (Ayres and Boehlje, 1979).

Average gasoline consumption (gallons/hour) =

maximum PTO or rated engine horsepower x .06.

Average fuel cost/hour = average gallons/hour x $1.20/gallon

or

average diesel consumption (gallons/hour) =

maximum PTO or rated engine horsepower x .044,

average fuel cost/hour = average gallons/hour x $.98/gallon.

Lubrication costs per hour were estimated as 15% of fuel costs (Ayres and Boehlje, 1979).

Repair costs per hour were estimated, using the wear-out life and total repair estimates given in Table 11 and Figure 7. In calculating repair costs per hour, it was assumed that all equipment was at the midpoint of its wear-out life. The following example illustrates how the graph in Figure 7 was used:

At midpoint in its wear-out life, the Sears tractor will have accumulated 50% of its lifetime hours or 1250 hours. At 50% of its lifetime hours, total accumulated repairs will equal 45% of the suggested retail price (Figure 7) or .45 x $2125 = $956. Repair costs per hour = $956÷1250 hours = $0.77/hour.

A 1979 estimate of operating costs for a pickup (Kelsey and Johnson, 1979) was inflated by 33% to obtain the estimate of $0.25 per mile in 1980.

Likewise, a 1979 estimate of operating costs for irrigation equipment (Kelsey and Johnson, 1979) was inflated by 33% to obtain the estimate of $5.00 per acre-inch in 1980.

Table 11. Machinery schedule for estimated wear-out life and repairs

Item	Estimated wear-out life (hours)	Total repairs in wear-out life as % list price	Repair curve (Figure 7)
Sears 16 hp tractor	2500	120	1
Sears plow	500	120	1
Sears disc	500	120	1
Sears cultivator	500	120	1
Sears rototiller	500	120	1
Sears spreader-seeder	250	100	2
Sears rotary mower	400	60	3
Sears drag harrow	500	120	1
Weed sprayer	1200	100	2
Solo sprayer	1200	120	1
Deere 27 hp tractor	8000	120	1
Deere plow	2500	120	1
Deere disc	2500	120	1
Deere cultivator	2500	120	1
Deere rototiller	2500	120	1
Deere spin spreader	1200	100	2
Deere rotary mower	2000	60	3
Deere drag harrow	2500	120	1
2-row transplanter	1200	60	3
Weed sprayer	1200	100	2
Broyhill sprayer	1200	100	2

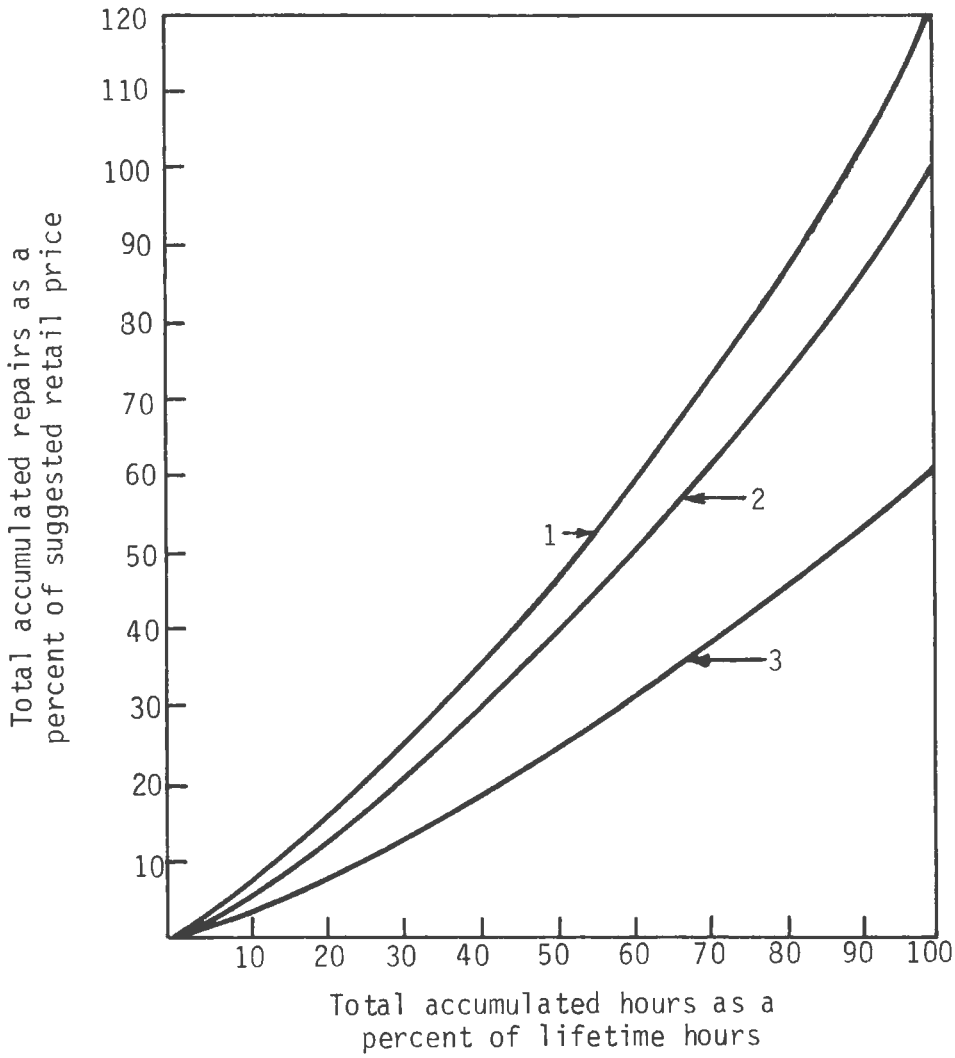

Figure 7. Total accumulated repair costs for tractors and implements (Kelsey and Price, 1979)

Estimates of the operating costs per hour for the given equipment are presented in Table 12.

Table 12. Operating costs per hour for equipment

Item	Fuel cost/hr	Oil cost/hr	Repair cost/hr	Variable cost/hr
Sears 16 hp tractor	$1.15	$.17	$ .77	$2.09
Sears plow	---	---	.29	.29
Sears disc	---	---	.25	.25
Sears cultivator	---	---	.23	.23
Sears rototiller	.58	.09	.72	1.39
Sears spreader-seeder	---	---	.33	.33
Sears rotary mower	---	---	.46	.46
Sears drag harrow	---	---	.23	.23
Solo sprayer	.90	.14	1.13	2.17
Deere 27 hp tractor	1.16	.17	.79	2.12
Deere plow	---	---	.37	.37
Deere disc	---	---	.36	.36
Multivator	---	---	.74	.74
Deere rototiller	---	---	.44	.44
Deere spin spreader	---	---	.50	.50
Deere rotary mower	---	---	.32	.32
Deere drag harrow	---	---	.26	.26
Broyhill sprayer	---	---	1.58	1.58
Weed sprayer	---	---	.38	.38
2-row transplanter	---	---	.39	.39
Pick-up				.25/mile
Irrigation equipment				5.00/AI

Summary of strawberry growing costs

Growing costs for the establishment, first crop, and second crop years are summarized in Tables 15 and 16. Labor, machinery, and materials costs were taken from Tables 13 and 14. A charge for land rent equivalent has been included. The land rent equivalent is a type of opportunity cost to the owner of devoting the land to strawberry production rather than collecting cash rent for the land.

PYO strawberry harvest costs

Costs to harvest an acre of pick-your-own strawberries are itemized in Table 17. The amount of supervision needed for a pick-your own strawberry farm will vary from farm to farm. For this study it was assumed that one supervisor per two acres would be needed (Courter, 1979). This person would be needed 12 hours per day for 20 days, or 240 hours per 2 acres or 120 hours per acre.

It was also assumed that a check-out person would be needed 12 hours per day for 20 days. This 240 hours divided by 5 acres equals 48 hours per acre.

Various types of containers are available for pick-your-own marketing One type of container, i.e., 10-lb. wax-coated trays were chosen for analysis. Assuming a yield of 10,000 pounds per acre, 1000 trays would be needed.

Total costs

Total costs were obtained by adding growing costs, harvest costs, and fixed costs. Total costs per acre are itemized in Tables 18 and 19.

Table 13. Strawberry growing costs per acre using the Sears equipment

Operation	Labor			Machinery
	Labor hours	Wage rate	Cost	Equipment used
Fall, establishment year				
Plow	5	$4.00	$20.00	16 hp tractor Plow
Disc (twice)	3	4.00	12.00	16 hp tractor Disc
Seed rye	1.5	4.00	6.00	16 hp tractor Spreader-seeder
Fumigation				Custom application
Drag	1.5	4.00	6.00	16 hp tractor Drag harrow
Spring, establishment year				
Plow-down Fertilizer	1	4.00	4.00	16 hp tractor Spreader-seeder
Plow	5	4.00	20.00	16 hp tractor Plow
Disc (twice)	3	4.00	12.00	16 hp tractor Disc
Drag	1.5	4.00	6.00	16 hp tractor Drag harrow
Planting	45	4.00	180.00	Pickup
Topdress fertilizer	1	4.00	4.00	16 hp tractor Spreader-seeder
Herbicide spray	.5	4.00	2.00	16 hp tractor Weed sprayer
Cultivation (6 times)	9.0	4.00	36.00	16 hp tractor Cultivator
Hoeing (3 times)	30.0	4.00	120.00	
Remove flowers (2 times)	32.0	4.00	128.00	

Hours of use	Cost per hr	Cost	Materials Item	Cost/A	Total cost per acre
5	$2.09	$10.45			$31.90
5	.29	1.45			
3	2.09	6.27			19.02
3	.26	.75			
1.5	2.09	3.14	Rye, 2 bu/A	6.00	15.64
1.5	.33	.50	@ $3.00/bu		
				868.00	868.00
1.5	2.09	3.14			9.49
1.5	.23	.35			
1	2.09	2.09	100 lbs P_2O_5 @ $230/T	11.50	24.02
1	.33	.33	100 lbs K_2O @ $122/T	6.10	
5	2.09	10.45			31.90
5	.29	1.45			
3	2.09	6.27			19.02
3	.25	.75			
1.5	2.09	3.14			9.49
1.5	.23	.35			
3 mi	.25	.75	6225 plants 2'x3½' @ $50/1000	311.25	506.40
			24 lb starter fertilizer @ .60/lb.	14.40	
1	2.09	2.09	100 lb NH_4NO_3	15.15	21.57
1	.33	.33	@ $303/T		
.5	2.09	1.05	12 lbs Dacthal/A sprayed @ 2.99/lb	17.94	21.18
.5	.38	.19	Spray .5 area		
9.0	2.09	18.81			56.88
9.0	.23	2.07			
					120.00
					128.00

Table 13. *Continued*

Operation	Labor			Machinery
	Labor hours	Wage rate	Cost	Equipment used
First spray	1.0	4.00	4.00	16 hp tractor Sprayer
Second spray	1.0	4.00	4.00	16 hp tractor Sprayer
Third spray	1.0	4.00	4.00	16 hp tractor Sprayer
Fourth spray	1.0	4.00	4.00	16 hp tractor Sprayer
Irrigation-set up equipment	2	4.00	8.00	Pickup
Application of one-acre inch (5 times)	.5	4.00	2.00	Irrigation equipment
Topdress fertilizer	1	4.00	4.00	16 hp tractor Spreader-seeder
Cut runners in the fall	1	4.00	4.00	16 hp tractor Cultivator
Herbicide spray	.5	4.00	2.00	16 hp tractor Weed sprayer
Mulching	7.0	4.00	28.00	Pickup

Hours of use	Cost per hr	Cost	Materials Item	Cost/A	Total cost per acre
1.0	2.09	2.09	2 pt. Guthion/A @ $2.58/pt.	5.16	18.47
1.0	2.17	2.17	1 lb Cyprex/A @ $5.05/lb.	5.05	
1.0	2.09	2.09	2 pt Guthion/A @ $2.58/pt.	5.16	18.47
1.0	2.17	2.17	1 lb Cyprex/A @ $5.05/lb.	5.05	
1.0	2.09	2.09	2½ lb Kelthane/A @ $2.95/lb.	7.38	25.85
1.0	2.17	2.17	2 pt. Guthion/A @ $2.58/pt.	5.16	
			1 lb. Cyprex/A @ $5.05/lb.	5.05	
1.0	2.09	2.09	2 pt. Guthion/A @ $2.58/pt.	5.16	18.47
1.0	2.17	2.17	1 lb. Cyprex/A @ $5.05/lb.	5.05	
6 mi	.25	1.50			9.50
5 AI	5.00	25.00			27.00
1	2.09	2.09	100 lb NH_4NO_3 @ $303/T	15.15	21.57
1	.33	.33			
1	2.09	2.09			6.32
1	.23	.23			
.5	2.09	1.05	12 lb Enide/A	19.08	22.32
.5	.38	.19	sprayed @ $3.18/lb. Spray .5 area		
8 mi	.25	2.00	125 bales straw @ $1.00/bale	125.00	155.00

Table 13. *Continued*

Operation	Labor hours	Labor — Wage rate	Labor — Cost	Machinery — Equipment used
Growing costs, establishment year		Labor	$620.00	
First crop year				
Set up irrigation equipment	2	$4.00	$ 8.00	Pickup
Set straw off rows	8	4.00	32.00	
Frost control	3.5	4.00	14.00	Irrigation equipment
First cover spray	1.0	4.00	4.00	16 hp tractor Sprayer
Second cover spray	1.0	4.00	4.00	16 hp tractor Sprayer
Third cover spray	1.0	4.00	4.00	16 hp tractor Sprayer
Pre-harvest spray	1.0	4.00	4.00	16 hp tractor Sprayer
Pre-harvest spray	1.0	4.00	4.00	16 hp tractor Sprayer

Hours of use	Cost per hr	Cost	Materials Item	Cost/A	Total cost per acre
			Subtotal	$1457.79	
			Interest @ 12%, 14 months	204.09	204.09
Machinery		$127.69	Materials	$1661.38	$2409.57
6 mi	$ .25	$ 1.50			$ 9.50
					32.00
4 AI	5.00	20.00			34.00
1.0	2.09	2.09	6 lb Captan @ $1.48/lb.	8.88	17.14
1.0	2.17	2.17			
1.0	2.09	2.09	2 lb. Thiodan @ $4.09/lb.	8.18	23.10
			½ lb. Benlate @ $10.35/lb.	5.18	
			1 lb Captan @ $1.48/lb	1.48	
1.0	2.17	2.17			
1.0	2.09	2.09	½ lb. Benlate @ $10.35/lb.	5.18	14.92
			1 lb Captan @ $1.48/lb.	1.48	
1.0	2.17	2.17			
1.0	2.09	2.09	½ lb. Benlate @ $10.35/lb.	5.18	17.53
			1 lb Thiodan @ $4.09/lb.	4.09	
1.0	2.17	2.17			
1.0	2.09	2.09	½ lb. Benlate @ $10.35/lb	5.18	13.44
1.0	2.17	2.17			

Table 13. *Continued*

Operation	Labor hours	Wage rate	Cost	Machinery Equipment used
Hoeing	16.0	4.00	64.00	
Irrigation one acre-inch (5 times)	.5	4.00	2.00	Irrigation equipment
Growing costs, first crop year		Labor	$140.00	
Second crop year				
Mowing	1.0	4.00	4.00	16 hp tractor Rotary mower
Fertilizer	1.0	4.00	4.00	16 hp tractor Spreader-seeder
Rototill	3.0	4.00	12.00	16 hp tractor Rototiller
Herbicide spray	.5	4.00	2.00	16 hp tractor Weed sprayer
Summer spray (twice)	2.0	4.00	8.00	16 hp tractor Sprayer

Hours of use	Cost per hr	Cost	Materials — Item	Cost/A	Total cost per acre
					64.00
5 AI	5.00	25.00	1 lb. Captan @ $1.48/lb ½ lb. Benlate @ $10.35/lb on three irrigations 2 pts. Guthion @ $2.58/pt. on 2 irrigations	19.97 10.32	57.29
			Subtotal	$75.12	
			Interest @ 12%, 2 months	1.50	1.50
Machinery		$67.80	Materials	$76.62	$284.42
1.0 1.0	2.09 .46	2.09 .46			6.55
1.0 1.0	2.09 .33	2.09 .33	100 lb NH_4NO_3 @ $303/T	15.15	21.57
3.0 3.0	2.09 1.39	6.27 4.17			22.44
.5	2.09	1.05	8 lb Tenoran/A sprayed @ $3.58/lb spray .5 area	14.32	36.64
.5	.38	.19	12 lb Enide/A sprayed @ $3.18/lb spray .5 area	19.08	
2.0 2.0	2.09 2.17	4.18 4.34	½ lb Benlate/A @ $10.35/lb. 2 pts Guthion/A @ 2.58/pt. 1 lb Captan/A @ 1.48/lb.	23.63	40.15

Table 13. *Continued*

Operation	Labor hours	Labor Wage rate	Labor Cost	Machinery Equipment used
Hoeing (3 times)	48.0	4.00	192.00	
Fall irrigation one acre-inch (4 times)	.5	4.00	2.00	Irrigation equipment
Cultivation (twice)	3.0	4.00	12.00	16 hp tractor Cultivator
Mulching	7.0	4.00	28.00	Pickup
Spring, second crop year				
Set up irrigation equipment	2.0	4.00	8.00	Pickup
Set straw off rows	8.0	4.00	32.00	
Frost control	3.5	4.00	14.00	Irrigation equipmt.
First cover spray	1.00	4.00	4.00	16 hp tractor Sprayer
Herbicide spray (twice)	1.00	4.00	4.00	16 hp tractor Weed sprayer
Second cover spray	1.0	4.00	4.00	16 hp tractor Sprayer
Third cover spray	1.0	4.00	4.00	16 hp tractor Sprayer
Pre-harvest spray	1.0	4.00	4.00	16 hp tractor Sprayer
Pre-harvest spray	1.0	4.00	4.00	16 hp tractor Sprayer

Hours of use	Cost per hr	Cost	Materials Item	Cost/A	Total cost per acre
					192.00
4 AI	5.00	20.00			22.00
3.0	2.09	6.27			18.96
3.0	.23	.69			
8 mi	.25	2.00	125 bales straw @ $1.00/bale	125.00	135.00
6 mi	.25	1.50			9.50
					32.00
4 AI	5.00	20.00			34.00
1.0	2.09	2.09	6 lb Captan @	8.88	17.14
1.0	2.17	2.17	$1.48/lb		
1.0	2.09	2.09	8 lb Tenoran @	14.32	20.79
1.0	.38	.38	$3.58/lb.		
			12 lb Enide @ $3.18/lb spray .5 area		
1.0	2.09	2.09	2 lb Thiodan @	8.18	23.10
1.0	2.17	2.17	$4.09/lb		
			½ lb Benlate @ $10.35/lb.	5.18	
			1 lb Captan @ $1.48/lb	1.48	
1.0	2.09	2.09	½ lb. Benlate @	5.18	14.92
1.0	2.17	2.17	$10.35/lb.		
			½ lb. Captan @ $1.48/lb.	1.48	
1.0	2.09	2.09	½ lb. Benlate @	5.18	17.53
1.0	2.17	2.17	$10.35/lb.		
			1 lb. Thiodan @ $4.09/lb	4.09	
1.0	2.09	2.09	½ lb. Benlate @	5.18	13.44
1.0	2.17	2.17	$10.35/lb.		
			Subtotal	$256.33	

Table 13. *Continued*

Operation	Labor hours	Wage rate	Cost	Machinery Equipment used
Hoeing	16.0	$4.00	$64.00	
Irrigation one acre-inch (3 times)	.5	4.00	2.00	Irrigation equipment
Growing costs, second crop year			Labor $408.00	

Hours of use	Cost per hr	Cost	Materials Item	Cost/A	Total cost per acre
					$64.00
3 AI	5.00	15.00			17.00
			Interest @ 12%, 12 months	30.76	30.76
Machinery		$114.40	Materials	$287.09	$809.49

Table 14. Strawberry growing costs per acre using the Deere equipment

Operations	Labor			Machinery
	Labor hours	Wage rate	Cost	Equipment used
Fall, establishment year				
Plow	2.0	$4.00	$ 8.00	27 hp tractor Plow
Disc (twice)	1.0	4.00	4.00	27 hp tractor Disc
Seed rye	.5	4.00	2.00	27 hp tractor Spin spreader
Drag	.5	4.00	2.00	27 hp tractor Drag
Fumigation				
Spring, establishment year				
Plow-down fertilizer	.5	4.00	2.00	27 hp tractor Spin spreader
Plow	2.0	4.00	8.00	27 hp tractor Plow
Disc (twice)	1.0	4.00	4.00	27 hp tractor Disc
Drag	.5	4.00	2.00	27 hp tractor Drag
Planting	1.5	4.00	6.00	27 hp tractor Transplanter Pickup
Topdress fertilizer	.5	4.00	2.00	27 hp tractor Spin spreader
Herbicide spray	.5	4.00	2.00	27 hp tractor Weed sprayer
Cultivation (6 times)	6.0	4.00	24.00	27 hp tractor Cultivator

Hours of use	Cost per hr	Cost	Materials: Item	Materials: Cost/A	Total cost per acre
2	$2.12	$ 4.24			$12.98
2	.37	.74			
1	2.12	2.12			6.48
1	.36	.36			
.5	2.12	1.06	2 bushels rye @ $3.00/bu	6.00	9.31
.5	.50	.25			
.5	2.12	1.06			3.19
.5	.26	.13			
			Custom application	868.00	868.00
.5	2.12	1.06	100 lbs P_2O_5 @ $230/T	11.50	20.91
.5	.50	.25	100 lbs K_2O @ $122/T	6.10	
2.0	2.12	4.24			12.98
2.0	.37	.74			
1.0	2.12	2.12			6.48
1.0	.36	.36			
.5	2.12	1.06			3.19
.5	.26	.13			
1.5	2.12	3.18	6225 plants@ $50/1000	311.25	336.17
1.5	.39	.59			
3 mi	.25	.75	24 lb. starter fertilizer @ $.60/lb.	14.40	
.5	2.12	1.06	100 lb NH_4NO_3 $303/T	15.15	18.46
.5	.50	.25			
.5	2.12	1.06	12 lb. Dacthal/A sprayed @ $2.99/lb spray .5 of area	17.94	21.19
.5	.38	.19			
6.0	2.12	12.72			41.16
6.0	.74	4.44			

Table 14. *Continued*

Operation	Labor			Machinery
	Labor hours	Wage rate	Cost	Equipment used
Hoeing (3 times)	30.0	4.00	120.00	
Remove flowers (twice)	32.0	4.00	128.00	
First spray	.5	4.00	2.00	27 hp tractor Sprayer
Second spray	.5	4.00	2.00	27 hp tractor Sprayer
Third spray	.5	4.00	2.00	27 hp tractor Sprayer
Fourth spray	.5	4.00	2.00	27 hp tractor Sprayer
Irrigation-set up equipment	2	4.00	8.00	Pickup
Application of one-acre inch 5 times	.5	4.00	2.00	Irrigation equipment
Topdress fertilizer	.5	4.00	2.00	27 hp tractor Spin spreader
Cut runners in the fall	1.0	4.00	4.00	27 hp tractor Cultivator
Herbicide spray	.5	4.00	2.00	27 hp tractor Weed sprayer

Hours of use	Cost per hr	Cost	Materials: Item	Materials: Cost/A	Total cost per acre
					120.00
					128.00
.5	2.12	1.06	2 pt. Guthion @ $2.58/pt.	5.16	14.06
.5	1.58	.79	1 lb. Cyprex $ $5.05/lb.	5.05	
.5	2.12	1.06	2 pt. Guthion @ $2.58/pt.	5.16	14.06
.5	1.58	.79	1 lb Cyprex @ $5.05/lb.	5.05	
.5	2.12	1.06	2½ lb Kelthane @ $2.95/lb.	7.38	21.44
.5	1.58	.79	2 pt. Guthion @ $2.58/pt.	5.16	
			1 lb Cyprex $ $5.05/lb.	5.05	
.5	2.12	1.06	2 pt. Guthion @ $2.58/pt.	5.16	14.06
.5	1.58	.79	1 lb. Cyprex @ $5.05/lb.	5.05	
6 mi	.25	1.50			9.50
5 AI	5.00	25.00			27.00
.5	2.12	1.06	100 lb NH_4NO_3 @ $303/T	15.15	18.46
.5	.50	.25			
1.0	2.12	2.12			6.86
1.0	.74	.74			
.5	2.12	1.06	12 lb Enide/A sprayed @ $3.18/ lb, spray .5 area	19.08	22.33
.5	.38	.19			

Table 14. *Continued*

Operation	Labor hours	Wage rate	Cost	Machinery Equipment used
Mulching	7.0	$4.00	$28.00	Pickup
Growing costs, establishment year		Labor	$368.00	
First crop year				
Set up irrigation equipment	2.0	4.00	8.00	Pickup
Set straw off rows	8.0	4.00	32.00	
Frost control	3.5	4.00	14.00	Irrigation equipmt.
First cover spray	.5	4.00	2.00	27 hp tractor Sprayer
Second cover spray	.5	4.00	2.00	27 hp tractor Sprayer
Third cover spray	.5	4.00	2.00	27 hp tractor Sprayer
Pre-harvest spray	.5	4.00	2.00	27 hp tractor Sprayer
Preharvest spray	.5	4.00	2.00	27 hp tractor Sprayer
Hoeing	16.0	4.00	64.00	

Hours of use	Cost per hr	Cost	Materials — Item	Cost/A	Total cost per acre
8 mi	$ .25	$ 4.00	125 bales straw @ $1.00/bale	$125.00	$157.00
			Subtotal	$1457.79	
			Interest @ 12%, 14 months	204.09	204.09
Machinery		$87.48	Materials	$1661.88	$2117.36
6 mi	.25	1.50			9.50
					32.00
4 AI	5.00	20.00			34.00
.5 .5	2.12 1.58	1.06 .79	6 lb Captan @ $1.48/lb	8.88	12.73
.5 .5	2.12 1.58	1.06 .79	2 lb Thiodan @ $4.09/lb. ½ lb. Benlate @ $10.35/lb. 1 lb Captan @ $1.48/lb.	8.18 5.18 1.48	18.69
.5 .5	2.12 1.58	1.06 .79	½ lb Benlate @ $10.35/lb. 1 lb Captan @ $1.48/lb.	5.18 1.48	10.51
.5 .5	2.12 1.58	1.06 .79	½ lb Benlate @ $10.35/lb. 1 lb Thiodan @ $4.09/lb.	5.18 4.09	13.12
.5 .5	2.12 1.58	1.06 .79	½ lb Benlate @ $10.35/lb.	5.18	9.03
					64.00

Table 14. *Continued*

Operation	Labor hours	Wage rate	Cost	Machinery Equipment used
Irrigation one acre-inch (5 times)	.5	4.00	2.00	Irrigation equipmt.
Growing costs, first crop year		Labor	$130.00	
Second crop year				
Mowing	1.0	4.00	4.00	27 hp tractor Rotary mower
Fertilizer	.5	4.00	2.00	27 hp tractor Spin spreader
Rototill	3.0	4.00	12.00	27 hp tractor Multivator
Herbicide spray	.5	4.00	2.00	27 hp tractor Weed sprayer
Summer spray (twice)	1.0	4.00	4.00	27 hp tractor Sprayer
Hoeing (3 times)	48.0	4.00	192.00	

Hours of use	Cost per hr	Cost	Materials — Item	Materials — Cost/A	Total cost per acre
5 AI	5.00	25.00	1 lb Captan @ $1.48/lb.	19.97	57.29
			½ lb Benlate @ $10.35/lb on 3 irrigations		
			2 pts. Guthion @ on 2 irrigations @ $2.58/pt.	10.32	
			Subtotal	$75.12	
			Interest @ 12%, 2 months	1.50	1.50
	Machinery	$55.75	Materials	$76.62	$262.37
1.0	2.12	2.12			6.44
1.0	.32	.32			
.5	2.12	1.06	100 lb NH_4NO_3 @ $303/T	15.15	18.46
.5	.50	.25			
3.0	2.12	6.36			20.58
3.0	.74	2.22			
.5	2.12	1.06	8 lb Tenoran/A sprayed @ $3.58/lb Spray .5 area	14.32	36.65
.5	.38	.19			
			12 lb Enide/A sprayed @ $3.18/lb Spray .5 area	19.08	
1.0	2.12	2.12	½ lb Benlate @ $10.35/lb.	23.63	31.33
1.0	1.58	1.58	2 pts. Guthion @ $2.58/pt.		
			1 lb Captan @ $1.48/lb.		
					192.00

Table 14. *Continued*

Operation	Labor hours	Labor Wage rate	Labor Cost	Machinery Equipment used
Fall irrigation one acre-inch (4 times)	.5	$4.00	$ 2.00	Irrigation equipmt
Cultivation (twice)	2.0	4.00	8.00	27 hp tractor Multivator
Mulching	7.0	4.00	28.00	Pickup
Spring, second crop year				
Set up irrigation equipment	2.0	4.00	8.00	Pickup
Set straw off rows	8.0	4.00	32.00	
Frost control	3.5	4.00	14.00	Irrigation equipmt.
First cover spray	.5	4.00	2.00	27 hp tractor Sprayer
Herbicide spray (twice)	1.0	4.00	4.00	27 hp tractor Weed sprayer
Second cover spray	.5	4.00	2.00	27 hp tractor Sprayer
Third cover spray	.5	4.00	2.00	27 hp tractor Sprayer
Pre-harvest spray	.5	4.00	2.00	27 hp tractor Sprayer
Pre-harvest spray	.5	4.00	2.00	27 hp tractor Sprayer

Table 14. *Continued*

Operation	Labor			Machinery
	Labor hours	Wage rate	Cost	Equipment used
Hoeing	16.0	4.00	64.00	
Irrigation one acre-inch (3 times)	.5	4.00	2.00	Irrigation equipment
Growing costs, second crop year		Labor	$388.00	

Hours of use	Cost per hr	Cost	Materials: Item	Materials: Cost/A	Total cost per acre
4 AI	$ 5.00	$20.00			$22.00
2.0	2.12	4.24			13.72
2.0	.74	1.48			
8 mi	.25	2.00	125 bales straw @ $1.00/bale	125.00	155.00
6 mi	.25	1.50			9.50
					32.00
4 AI	5.00	20.00			34.00
.5	2.12	1.06	6 lb Captan @	8.88	12.73
.5	1.58	.79	$1.48/lb.		
1.0	2.12	2.12	8 lb Tenoran @	14.32	20.82
1.0	.38	.38	$3.58/lb.		
			12 lb Enide @ $3.18/lb.		
			Spray .5 area		
.5	2.12	1.06	2 lb Thiodan @	8.18	18.69
.5	1.58	.79	$4.09/lb.		
			½ lb. Benlate @ $10.35/lb.	5.18	
			1 lb. Captan @ $1.48/lb.	1.48	
.5	2.12	1.06	½ lb Benlate @	5.18	10.51
.5	1.58	.79	$10.35/lb.		
			1 lb Captan @ $1.48-lb.	1.48	
.5	2.12	1.06	½ lb. Benlate @	5.18	13.12
.5	1.58	.79	$10.35/lb.		
			1 lb Thiodan @ $4.09/lb.	4.09	
.5	2.12	1.06	½ lb Benlate @	5.18	9.03
.5	1.58	.79	$10.35/lb.		
			Subtotal	$256.33	

Hours of use	Cost per hr	Cost	Materials Item	Cost/A	Total cost per acre
					64.00
3 AI	5.00	15.00			17.00
			Interest @ 12%, 12 months	30.76	30.76
Machinery		$93.25	Materials	$287.09	$768.34

Table 15. Summary of strawberry growing costs per acre using the Sears equipment

Item	Establishment year	First crop year	Second crop year
Labor	620.00	140.00	408.00
Machinery	127.69	67.80	114.40
Materials	1661.88	76.62	287.09
Land rent equivalent	100.00	100.00	100.00
Total growing costs	$2509.57	$384.42	$909.49

Table 16. Summary of strawberry growing costs per acre using the Deere equipment

Item	Establishment year	First crop year	Second crop year
Labor	368.00	130.00	388.00
Machinery	87.48	55.75	93.25
Materials	1661.88	76.62	287.09
Land rent equivalent	100.00	100.00	100.00
Total growing costs	$2217.36	$362.37	$868.34

Table 17. Costs of harvesting 1 acre of PYO strawberries

Item	Cost
Labor	
PYO supervision (120 hr. @ $4.00/hr.)	$480.00
Check-out (48 hr. @ $4.00/hr.)	192.00
Subtotal	$672.00
Materials	
1000 10-lb. wax-coated trays	221.60
Total annual harvest costs	$893.60

Table 18. Total costs per acre using the Sears equipment

Item	Establishment year	First crop year	Second crop year
Growing costs	$2509.57	$384.42	$ 909.49
PYO harvest costs	---	893.60	893.60
Fixed costs	705.10	705.10	705.10
Total costs per acre	$3214.67	$1983.12	$2508.19

Table 19. Total costs per acre using the Deere equipment

Item	Establishment year	First crop year	Second crop year
Growing costs	$2217.36	$ 362.37	$ 868.34
PYO harvest costs	---	893.60	893.60
Fixed costs	856.50	856.50	856.50
Total costs per acre	$3073.86	$2112.47	$2618.44

PROJECTED RETURNS, DISCUSSION, AND CONCLUSIONS

The cost estimates indicate that commercial production of strawberries requires a high per-acre investment.

Choice of equipment

The Sears equipment set originally cost about 3/4 as much as the Deere equipment set. The annual fixed cost of the Sears equipment was likewise about 3/4 that of the Deere equipment.

Growing costs were lower with the Deere equipment. Even though the Deere equipment was, in general, more expensive to operate on a per-hour basis, operations performed with the Deere equipment took less time, resulting in lower labor and machinery costs.

However, the lower total growing costs with the Deere equipment were not sufficient to offset the higher annual fixed costs. Perhaps, the Deere equipment set would be more suited to a farm size of 15 acres. If the annual fixed cost of the Deere equipment could be divided by 15 acres, the annual per-acre fixed cost would be $361, which would be lower than the $390 annual per-acre fixed cost of the Sears equipment for 10 acres. It is believed that 10 acres is about the maximum amount of acreage which could be farmed with the Sears equipment. Consequently, the Deere equipment allows more flexibility to the grower who might want to expand his or her acreage in the future.

Another advantage of the Deere equipment concerns timeliness of operations. For example, it was estimated that it would take 25 hours to plow

five acres with the Sears equipment as compared to 10 hours with the Deere equipment.

As a second example, transplanting with a two-row mechanical transplanter was estimated to require 7½ labor hours per five acres. Transplanting by hand was estimated to require 45 labor hours per acre, or 225 labor hours per five acres. With four people working 8-hour days, this operation would take 7 days to complete. Numerous problems would likely be encountered during the 7-day period, including inclement weather, boredom, and fatigue.

The difference in total costs between the two sets of equipment was small. In the establishment year, total costs using the Deere equipment were lower than total costs using the Sears equipment by $141 per acre. In the first and second crop years, total costs using the Deere equipment were higher than total costs using the Sears equipment by $129 and $110, respectively. Therefore, total costs with the Deere equipment averaged $33 per acre per year higher for the three-year period. Because this difference is relatively small, and, in order to simplify the following discussion, from here on, discussion will focus on the projected costs and returns using the Deere equipment.

The possibility of custom hiring certain operations is an option which was not considered in this study, except for custom fumigation. Certain operations, e.g., plowing, are performed only once or twice every few years. Perhaps it would be more economical for the grower to custom hire this work. However, a problem of timeliness might be encountered when depending on someone else to do the job.

Another option not considered in this study is that of renting certain pieces of equipment. Points to consider include availability of the desired machinery and rental cost.

Projected returns

The sum of total costs for the establishment year ($3074) and first crop year ($2112) is $5186. Break-even prices at various yields per acre for the first crop (at a cost of $5186 per acre) are illustrated in Figure 8. At a price of 50¢ per pound, the break-even yield for the first crop is 10,372 lbs/acre.

Break-even prices at various yields per acre for the second crop (at a cost of $2618 per acre) are illustrated in Figure 9. At a price of 50¢ per pound, the break-even yield for the second crop is 5,236 lbs/acre.

Average break-even prices for the first and second crops combined (at an average cost of $3902 per acre) are illustrated in Figure 10. At 50¢ per pound, the average break-even yield for the two crops is 7,804 lbs/acre.

Returns to management at various yields and prices are projected in Tables 20, 21, and 22.

Conclusions

Returns are projected to be negative or low for the first crop except at very high yields and prices.

Profits are more easily attained for the second crop due to lower total costs for that crop. A yield of 8000 to 10,000 pounds per acre sold at 50¢/lb. would result in profits of $1382 to $2382 per acre.

The process of renovation is less costly than that of planting and establishment. Consequently, the grower will maximize profits by keeping the strawberry planting in high-yielding condition for as many years as possible. Costs in subsequent years should be similar to those of the second crop year.

The findings of this study suggest that there is a potential for profit in pick-your-own strawberries in Story County, Iowa, if more than one crop can be harvested and if reasonably high yields can be attained.

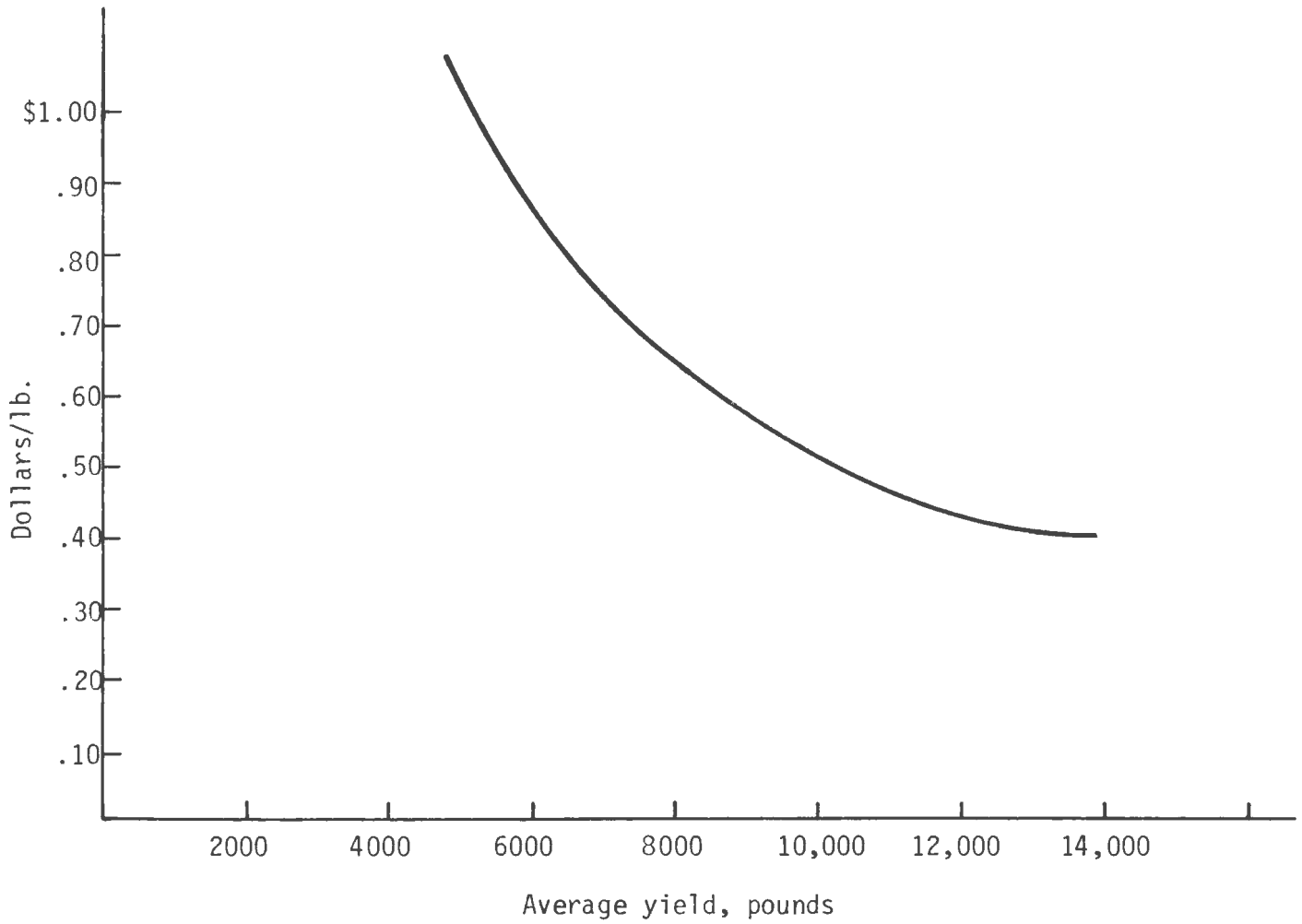

Figure 8. Break-even prices at various yields per acre for first crop of PYO strawberries at cost of $5186/A

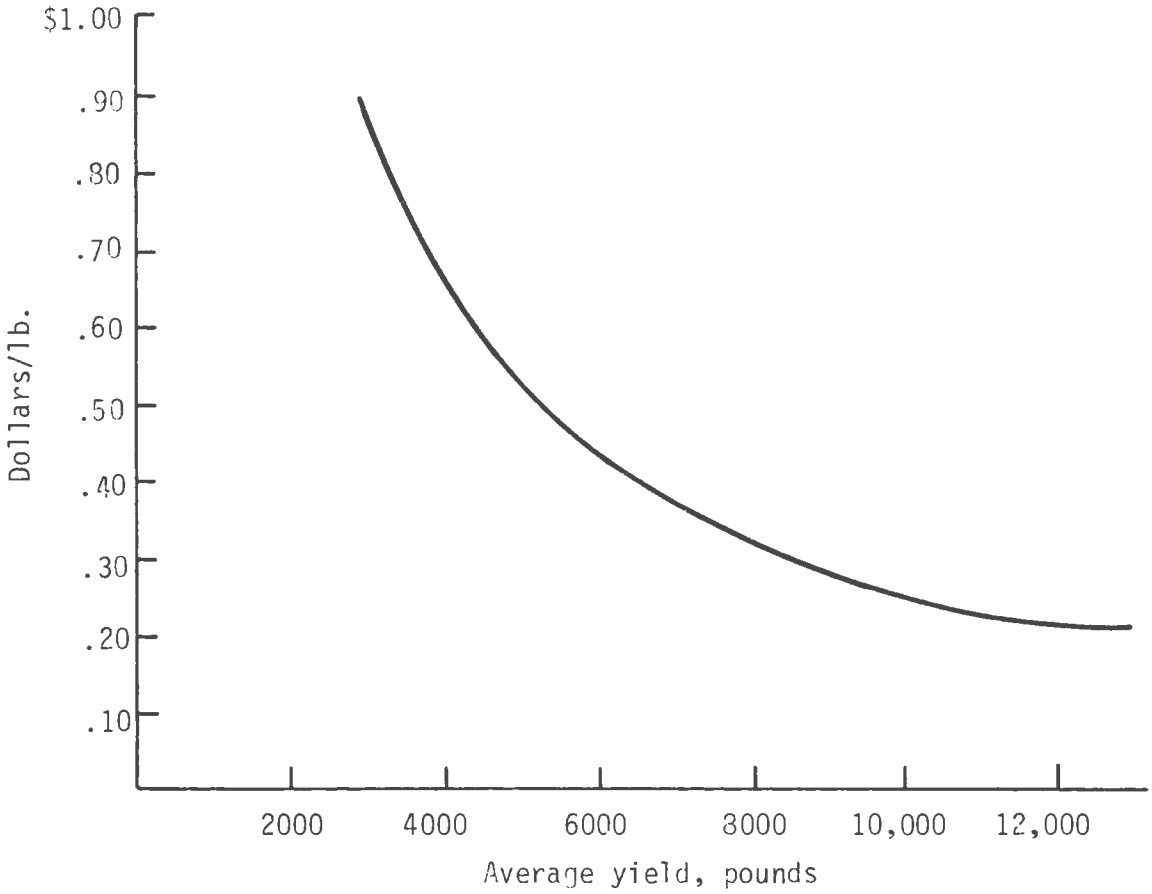

Figure 9. Break-even prices for various yields per acre for second crop of PYO strawberries at cost of $2618/A

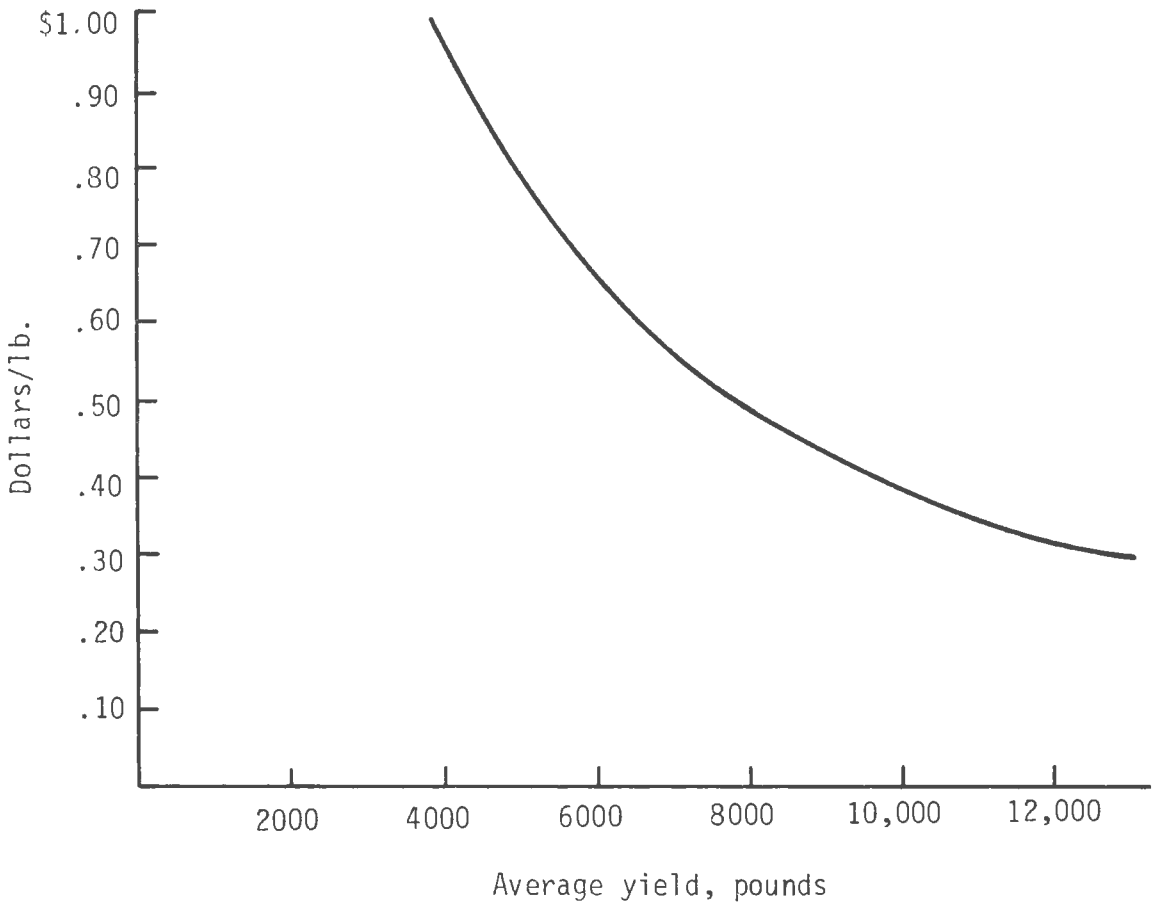

Figure 10. Break-even prices at various average yields per acre for two crops of PYO strawberries at average cost of $3902/A

Table 20. PYO strawberry management returns per acre in first crop year at various yields and prices

Yield (lbs/A)	Price (cents/lb) 40	50	60
	Returns (dollars/A)[a]		
4000	-3586	-3186	-2786
6000	-2786	-2186	-1586
8000	-1986	-1186	- 386
10000	-1186	- 186	814
12000	- 386	814	2014

[a]Returns based on total costs of $5186/A.

Table 21. PYO strawberry management returns per acre in second crop year at various yields and prices

Yield (lbs/A)	Price (cents/lb) 40	50	60
	Returns (dollars/A)[a]		
4000	-1018	- 618	- 218
6000	- 218	382	982
8000	582	1382	2182
10000	1382	2382	3382
12000	2182	3382	4582

[a]Returns based on total costs of $2618/A.

Table 22. Average PYO strawberry management returns per acre in first and second crop years at various yields and prices

Yield (lbs/A)	Price (cents/lb) 40	50	60
	Returns (Dollars/A)[a]		
4000	-2302	-1902	-1502
6000	-1502	- 902	- 302
8000	- 702	99	899
10000	99	1099	2099
12000	899	2099	3299

[a]Returns based on average cost of $3902/A.

RECOMMENDATIONS

Recommendations to farmers

Story County farmers are advised to assess their financial and physical resources in order to determine their capabilities for strawberry production. If an acreage is fertile, well-drained, and not too steep, and if the topography allows good air drainage, the acreage is well-suited to growing strawberries. In addition, the proposed site should be as weed-free as possible with no special insect or disease problems.

It should be recognized that a strawberry planting requires attention at the same time as field crops. If adequate labor is not available during the growing season, the strawberry operation should not be undertaken.

Considering the sizable financial investment required to produce strawberries, a grower cannot afford to be lacking in either knowledge or managerial skills.

In the sense that strawberries require a higher per-acre investment than that of agronomic crops, growing strawberries involves a greater financial risk. Likewise, the potential for per-acre profit is greater for strawberries than for corn or soybeans.

At present, there appears to be a market for pick-your-own strawberries in Story County. However, it must be recognized that a pick-your-own market may become saturated with the addition of only a few acres in strawberry production.

Recommendations to educators

Instructors in our high schools, area schools and colleges are advised to offer instruction in strawberry culture, management and marketing. It is believed that the management and marketing aspects are equally as important as the cultural methods. A lack of understanding in any one or more areas will lessen the entrepreneur's chance of success.

It is suggested that the instructor present to the students as much pertinent information as possible. The student will then be prepared to judge the advisability of establishing a strawberry farm.

Cooperative extension personnel are encouraged to assist local growers in their efforts to establish strawberry plantings.

Recommendations for further study

It is recognized that the pick-your-own market in a local area has definite limits which are determined by the population density of that area. Consequently, it is recommended that the economic feasibility of wholesale marketing of strawberries in Story County be investigated.

Furthermore, it is suggested that researchers investigate the feasibility of commercial fruit and vegetable production throughout the state of Iowa. Species suggested for consideration are: apples, raspberries, asparagus, lettuce, peas, sweet corn, tomatoes and squash.

It is also recommended that more research be directed toward determining the optimum choice of equipment for the small farm of 10 acres or less.

LITERATURE CITED

Antle, Glen G. 1978. Pick your own. Mich. St. Univ. Coop. Ext. Serv. Bull. E-1246. 12 pp.

Ayres, George E., and Michael Boehlje. 1979. Estimating farm machinery costs. Iowa St. Univ. Coop. Ext. Serv. Pm-710. 12 pp.

Childers, Norman F. 1976. Modern fruit science. 7th ed. J. B. Lippincott Co., Chicago, Ill. 970 pp.

Courter, J. W. 1979. Pick-your-own marketing of fruits and vegetables. Univ. Ill. Coop. Ext. Serv. HM-1-79.

Courter, J. W., and C. M. Sabota. 1980. Retail trade areas for pick-your-own strawberry farms in Illinois. Proc. 1980 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 21:18-21.

Courter, J. W., C. C. Doll, and D. B. Meador. 1978. Strawberry cultivars for Illinois, 1978. Proc. 1978 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 6:13-16.

Courter, J. W., C. M. Sabota, J. C. O. Nyankori, and R. E. Westgren. 1979. Customer distribution and purchases on selected pick-your-own strawberry farms in illinois. Proc. 1979 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 14:40-49.

Craig, D. L. 1978. Strawberry culture in eastern Canada. Proc. 1978 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 6:26-47.

Dana, Malcolm N. 1980. The strawberry plant and its environment. Proc. 1980 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 21:1-10.

Davis, M. B. 1922. Correlations in the strawberry. Proc. Amer. Soc. Hortic. Sci. 19:260-263.

Doll, C. C. 1978. Fertilizers for strawberries. Proc. 1978 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 6:55-57.

Doll, C. C. 1979. Preparation for strawberries. Proc. 1979 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 14:4-5.

Harris, Duane, John Weirich, and Tim Lord. 1980. 1979 Iowa land value survey. Iowa St. Univ. Coop. Ext. Serv. Bull. FM-1779.

Kelsey, Myron P. 1980. Coping with inflation. American Fruit Grower 100(6):9.

Kelsey, Myron and Archie Johnson. 1979. Costs of strawberry production in southwestern Michigan. Mich. St. Univ. Coop. Ext. Serv. Bull. E-1114. 6 pp.

Kelsey, M. P. and Hugh Price. 1979. Computing production costs of fruits and vegetables for "pick-your-own" operations. Mich. St. Univ. Coop. Ext. Serv. Bull. E-941. 12 pp.

Kirschling, P. J., and G. H. Sullivan. 1979. Small-farm costs and returns: pick-your-own strawberries. Purdue Univ., Dept. of Horticulture, Agric. Exp. Stn. Bull. No. 232. 46 pp.

National Oceanic and Atmospheric Administration (N.O.A.A.). 1974. Climates of the states. Water Information Center, Inc., Port Washington, N. Y. 975 pp.

Oschwald, W. R., F. F. Riecken, R. I. Dideriksen, W. H. Scholtes, and F. W. Schaller. 1965. Principal soils of Iowa. Iowa St. Univ. Coop. Ext. Serv. Special Report No. 42. 76 pp.

Ourecky, Donald K. 1976. The strawberry grower's handbook. American Fruit Grower, Willoughby, Ohio. 98 pp.

Scott, D. H., F. J. Lawrence, and A. D. Draper. 1979. Strawberry varieties in the United States. U.S.D.A. Farmers' Bull. No. 1043. 26 pp.

Shoemaker, James S. 1975. Small fruit culture. 4th ed. The AVI Publishing Co., Westport, Conn. 339 pp.

Skirvin, R. M., and A. G. Otterbacher. 1979. Renovation of the strawberry planting. Proc. 1979 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 14:7-13.

Stadelbacher, Glenn J. 1978a. Strawberry fertility-when-where-why-how. Proc. 1978 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 6:51-54.

Stadelbacher, Glenn J. 1978b. Strawberry cultivation. Proc. 1978 Illinois Strawberry School. Univ. Ill. Coop. Ext. Serv. Hortic. Series 6:58-60.

U.S.D.A. Econ. Stat. Coop. Serv. 1978. State farm income statistics. Stat. Bull. No. 609 (Suppl.).

U.S.D.A. 1980. 1979 handbook of agricultural charts. Agric. Handbook No. 561.

Waite, Paul J. 1967. The climate of Iowa. Pages 657-659 in N.O.A.A. 1974. Climates of the states. Water Information Center, Inc., Port Washington, N. Y. 975 pp.

ACKNOWLEDGMENTS

Thanks to Dr. Paul Domoto and Dr. Ervin Denisen, two of my first teachers in horticulture.

Thanks to Dr. Alan Kahler for wisely suggesting that I narrow my thesis topic.

A special thanks to Dr. David Williams for his continual help and encouragement.

Special thanks also to Dr. Roger Ginder for his interest, patience, and guidance in economics.

Thanks also to Dean Henry, a Story County strawberry grower, for taking the time to talk with me.